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Prenatal isolated mild ventriculomegaly: outcome in 167 cases

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Objective To define the contribution of prenatal investigation and evaluate the prognosis of isolated mild ventriculomegaly (IMV).

Design Retrospective study.

Setting University hospital between January 1992 and December 2002.

Population One hundred and sixty-seven cases of prenatal unilateral or bilateral IMV without any associated anomaly at the time of initial diagnosis.

Methods Complementary investigations were performed: amniocentesis with karyotyping, screening for viruses and acetylcholinesterase electrophoresis, magnetic resonance imaging (MRI), and ultrasonography every 3–4 weeks.

Main outcome measures Results of prenatal investigations, pregnancy outcome, and postnatal psychomotor development.

Results IMV was diagnosed around 26.5 weeks. Amniocentesis revealed four chromosomal anomalies and two cytomegalovirus infections. MRI diagnosed brain-associated anomalies in 15 cases and ultrasonographic monitoring highlighted malformations not initially diagnosed in 28 cases. Termination of pregnancy (TOP) was considered in 21 pregnancies (12.6%). Indications were aneuploidy, fetal infectious disease or associated malformations. In women for whom a TOP was considered, consanguinity, fetus of female sex and frontal horn enlargement were statistically more frequent, ventriculomegaly was more often bilateral and asymmetrical, atrial width, and the rate of progressive ventricular enlargement were significantly higher. One hundred and one children with prenatal IMV were assessed between 19 and 127 months (mean age 54.68 ± 2.87 months). Twelve children had neurological disease or psychomotor delay and 89 children had a normal psychomotor development. Poor neurological outcome was more often associated with atrial width greater than or equal to 12 mm, asymmetrical bilateral enlargement, and progression of the ventriculomegaly.

Conclusion The detection of IMV raises the question of the child's psychomotor development and justifies meticulous prenatal investigation. In addition to associated anomalies, three criteria are often associated with an unfavourable outcome: atrial width greater than 12 mm, progression of the enlargement, and asymmetrical and bilateral ventriculomegaly.

Keywords Brain development, magnetic resonance imaging, ultrasound, ventriculomegaly.

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Introduction

Ventriculomegaly is the most frequent fetal brain anomaly, with a prevalence of around 1 per 1000 live births,[1,2] or even 22 per 1000 according to some authors.[3] Prognosis is poor, with a mortality of 70–80%, and only half of the surviving children develop normally.[2,4] The poor prognosis of ventriculomegaly is correlated with the associated malformations found in more than two-thirds of cases and an aneuploidy frequency of about 9%.[5] Isolated ventriculomegaly is characterised by the absence of associated anomalies. With a prevalence of 0.39–0.87 births per 1000,[6] the aetiology is generally unknown. Ventriculomegaly is considered mild when the atrial width is 10–15 mm. In the event of isolated mild ventriculomegaly (IMV), the prognosis is better, with a reported survival rate of 85%, with 85% of children experiencing normal development (Table 1). But IMV is a diagnosis of exclusion and justifies meticulous and detailed investigations in the search for associated anomalies, which is why most authors recommend systematic magnetic resonance imaging (MRI), repeated ultrasound checks, fetal karyotyping, and screening for fetal infections.

Table 1. Review

Studies	IMV, *n*	Live births (%)	Children with normal development (%)
Bromley *et al.*[1]	27	96	81
Goldstein *et al.*[2]	13	62	75
Alagappan *et al.*[3]	11	100	100
Pilu *et al.*[7]	31	93	93
Valat *et al.*[8]	12	100	83
Vergani *et al.*[9]	48	96	98
Patel *et al.*[10]	37	92	79
Kinzler *et al.*[11]	10	100	100
Senat *et al.*[12]	10	100	100
Girard *et al.*[13]	88	93	91
Graham *et al.*[14]	19	100	89
Den Hollander *et al.*[15]	5	100	60
Mahony *et al.*[16]	20	60	67
Mercier *et al.*[17]	26	100	81
Bloom *et al.*[18]	22	100	64
Nicolaides *et al.*[19]	58	33	67

We carried out a retrospective study of 167 cases of IMV to specify the contribution of investigations and follow up, to evaluate the prognosis of IMV, and to identify prenatal factors effecting postnatal development.

Material and methods

We carried out a retrospective study of IMV diagnosed in our department between 1 January 1992 and 31 December 2002. Our department is a reference centre, providing specialised prenatal diagnosis for the northern area of Paris. During this period, 167 cases of IMV were included. All fetuses had unilateral or bilateral ventriculomegaly with atrial width between 10 and 15 mm and without any associated anomaly at the time of the initial ultrasonographic detection. The ultrasonographic diagnosis was made by two operators of our department, specialised in fetal brain diseases. A complete and rigorous ultrasonographic examination was performed to search for associated anomalies of the central nervous system, or extracerebral anomalies, growth disorders, and amniotic fluid anomalies. Atrial width was measured on a coronal plane crossing the midheight atrium without including the ventricular wall. With this coronal plane, the two atrium could be visualised, as compared with the axial plane where only the ventricle furthest away from the probe is well seen (Figure 1).

Complementary investigations were performed: amniocentesis with karyotyping, screening for viruses (toxoplasmosis, other [congenital syphilis and viruses], rubella, cytomegalovirus [CMV] and herpes simplex virus), acetylcholinesterase

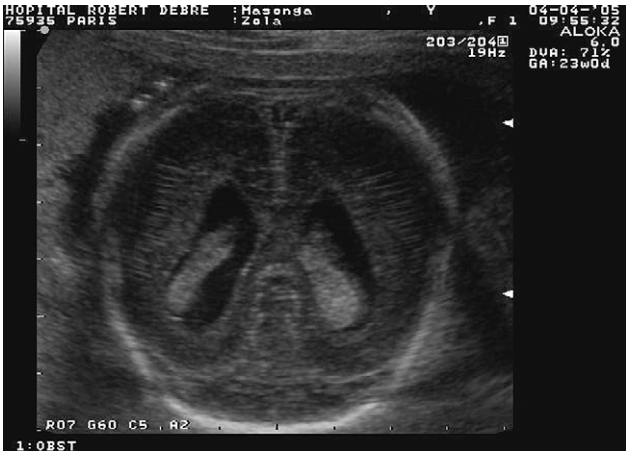

Figure 1. Coronal plane for atrial width measurement.

electrophoresis, MRI for a biometric study, analysis of ventricular morphology, and screening for brain anomalies. An ultrasonographic check was performed every 3–4 weeks to search for associated anomalies. The clinical course of ventriculomegaly was specified, as was the state of cerebral maturation.

Following the outcome of these investigations, in the event of an important risk of psychomotor handicap, a termination of pregnancy (TOP) was proposed, whatever the gestational age, in accordance with French law.

After exclusion of TOP, 146 children were born alive. One hundred and one of these children underwent psychomotor assessment and were included in the postnatal analysis. All the children were examined at birth and in the first week of life by a paediatrician, and early brain imaging was performed (ultrasound, then brain MRI as from 2002). Before June 1999, children were followed by a paediatrician of their choice. After June 1999, a specific follow-up protocol was set up in the paediatric neurology department of the hospital (Table 2); all the medical consultations involved a formal neurological examination and developmental assessment.

Table 2. Paediatric follow-up protocol

Examination at birth and transcranial ultrasound at 3 days
Medical consultation at 2 months
Brain MRI at 2 months
Medical consultation at 6 months
Medical consultation at 9 months
Medical consultation at 1 year
Psychometric evaluation at 1 year
Medical consultation at 18 months
Brain MRI before 2 years
Medical consultation at 2 years
Psychometric evaluation at 2 years
Medical consultation and psychometric evaluation each year

The neurological examinations were performed by the same paediatric neurologist, and all the neurodevelopmental assessments included mental and motor scales performed by a trained examiner. The methods of psychomotor assessment were decided according to the children's age. For children of 1 or 2 years of age, the Brunet–Lezine psychomotor scale revisited test[20] was used to assess global motor development, fine motor abilities, language and social skills; between age of 2 and 4 years, the McCarthy Scales of Children's Abilities[21] were used to assess motor development, fine motor abilities, language and memory, and after the age of 4 years, the children were assessed with the Wechsler Preschool and Primary Scale of Intelligence—Revised.[22]

For children not followed up in this protocol, data on psychomotor development were collected in the paediatric files of the children seen in consultation or by a questionnaire, prepared in collaboration with our paediatric neurologist (Table 3). For the children assessed by questionnaire, all of their paediatricians were contacted by telephone and most of these children consulted our neurologist, who determined their psychomotor development. Postnatal follow up in this study stopped on 1 January 2004.

All prenatal diagnosis data were collected and analysed in order to specify the contribution of the fetal investigations and to determine whether there are prognostic factors that influence postnatal outcome. Student's *t* test and the chi-square test were used for this analysis.

Table 3. Questionnaire

Name
Date of birth
Does your child have health problem?
Has your child already been hospitalised? For what reason?
At which age did your child first:
Smile?
Catch objects?
Sit down?
Walk?
Say his/her first words?
Make his/her first sentences?
Speak well (understood by all)?
Does he/she go to school?
In which class?
At which age did he/she start school?
Did he/she have to repeat a year?
How does his teacher judge his/her work?
Has your child already been seen by a:
physiotherapist?
speech therapist?
psychomotor therapist?
psychologist?
For what reason?

Results

Isolated mild fetal ventriculomegaly was diagnosed prenatally in 167 pregnancies. Median maternal age was 30 years (range: 19–44), 41.9% of the women were primiparous and 58.1% were multiparous. Concerning ethnic origin, 60.4% of the women were from France or another European country, 13.7% from Africa, 19.8% from North Africa, and 5.9% from Asia. Questioning revealed consanguinity in seven cases (4.2%). Fetal sex ratio was 1.31 (72 girls, 95 boys). IMV was detected around 26.5 weeks (range: 14–38). Ventriculomegaly was unilateral in 80 cases (48%), bilateral and symmetrical in 70 cases (42%), and bilateral and asymmetrical in 17 cases (10%). Median atrial width was 11 mm (range: 10–15). Frontal horns were dilated in 24 cases (14.5%). All the women underwent an amniocentesis. Amniocentesis highlighted four chromosomal anomalies: two 47 XY + 21, one 47 XXY and one 47 XYY and revealed two CMV infections. In one woman, fetal blood analysis revealed GM1 gangliosidosis. Acetylcholinesterase electrophoresis was always normal.

MRI was performed at 33 weeks (range: 24–39) in 123 cases. In nine cases (7.3%), the ventricles were normal, in 19 cases (15.4%), there were bilateral and asymmetrical ventriculomegaly, and ventriculomegaly was symmetrical in 33 cases (26.8%) and unilateral in 62 cases (50.4%). Median atrial width was 11.85 mm (range: 10–23) on the right and 11.5 mm (range: 10–21.8) on the left. Frontal horns were dilated in 22 cases (17.9%). In 15 cases (12.2%), MRI revealed major associated brain anomalies (Table 4). In 28 cases (16.8%), ultrasonographic monitoring highlighted extracerebral or intracerebral anomalies not initially diagnosed (Table 5). IMV remained stable in 55% of cases, regressed in 34%, and worsened in 11%.

TOP was considered in 21 cases (12.6%). In 16 cases, TOP was performed, in 3 cases it was refused, and in 2 cases, it was proposed but could not be performed for lack of time because of preterm delivery. Indications were aneuploidy in three cases, CMV infection in two cases, metabolic disease in one

Table 4. Major cerebral anomalies diagnosed with MRI

Anomalies diagnosed with MRI	*n* (%)	Cases also diagnosed by ultrasound examination
Third ventricle enlargement	6 (4.8)	2/6
Heterotopia	4 (3.2)	0/4
Septum pellucidum destruction	2 (1.6)	0/2
Partial agenesis of the corpus callosum	2 (1.6)	2/2
Agenesis of the cerebellar vermis	1 (0.8)	0/1
Total	15 (12.2)	4/15

Table 5. Associated anomalies diagnosed during ultrasonographic monitoring

	n	%
Major anomalies		
Agenesis of the corpus callosum	2	1.2
Third ventricle enlargement	3	1.8
Subependymal haemorrhage	1	0.6
Vertebral malformation	1	0.6
Polymalformative syndrome	2	1.2
Periventricular hyperechogenicity	1	0.6
Minor anomalies		
Hydronephrosis	2	1.2
Femur under the 10th percentile	5	3.0
Biparietal diameter at third percentile	1	0.6
Liver macrocalcifications	1	0.6
Hydramnios/oligoamnios	3	1.8
Intrauterine growth restriction	6	3.6
Total	28	16.8

case, severe ventriculomegaly with associated cerebral anomaly in 14 cases, and spinal anomaly in one case. All associated anomalies were confirmed at autopsy. For these 21 TOP proposals, the outcome of prenatal investigations are summarised in Table 6.

Prenatal data analysis highlighted that requests for TOP are more often associated with consanguinity (14.3% in the TOP proposals group versus 2.7% in the remainder of the population), fetus of female sex (66.7 versus 39.7%), and frontal horn dilatation (33.3 versus 11.6%). Ventriculomegaly was more often bilateral and asymmetrical in the women for whom a TOP was considered (52.9 versus 12.3%). Atrium was larger in the TOP proposal population (left: 13.8 versus 11.5 mm, right: 14.0 versus 11.6 mm) and the rate of progressive ventricular enlargement was higher (52.4 versus 12.3%).

After exclusion of TOP proposals, 146 children were born alive. One hundred and one of these children underwent psychomotor assessment and were included in the postnatal analysis with a follow-up rate of 69.2%. No systematic differences in the antenatal characteristics were observed between the children assessed and included in the analysis and the children for whom we have no follow-up data (45 children). Median gestational age at birth was 39 weeks (28–41 weeks), ten children were born between 28 and 37 weeks, nine of these by caesarean section. Neonatal examination revealed hypotonia in 11 children. Two twins had neonatal convulsions. Transcranial ultrasound on the third day of life detected ventriculomegaly in 62 (61.4%) newborns. On 1 January 2004, the children were between 19 and 127 months of age (mean 54.68 ± 2.87 months). Forty-six had undergone the complete paediatric follow-up protocol, 19 had one or more paediatric consultation in our hospital, and 36 were assessed through the questionnaire and their paediatrician's opinion. Mean duration of paediatric follow up was 43.81 ± 2.92 months, median duration was 34 months (range: 2–127). Twelve children (11.88%) had neurological disease or developmental delay assessed by a neuropaediatrician (Table 7), and 89 children (88.12%) had normal psychomotor development.

There were differences in prenatal findings between the group with neurological complications (group 1, $n = 12$) and the group with normal development (group 2, $n = 89$).

At the time of initial ultrasound examination, the ventricles appeared more dilated in the neurological disease group. Right and left atria measured, respectively, 11.25 ± 0.41 mm and 11.58 ± 0.35 mm in group 1 versus 10.96 ± 0.12 mm and 10.95 ± 0.12 mm in group 2 (nonsignificant for the right ventricle, $P = 0.05$ for the left ventricle). If, as in many publications, we consider 12 mm as the cutoff,[7,23] neurological outcome was worse if one or both atria had a size equal to or greater than 12 mm. Indeed, 66.7% of the pathological cases had one or both ventricles equal to or greater than 12 mm versus 28.1% of the remainder of the population ($P = 0.02$).

Asymmetrical bilateral ventriculomegaly was more frequently associated with poor neurological outcome ($P = 0.003$). In 50% of cases, asymmetrical dilation was associated with postnatal neurological disease versus 7.5% for unilateral dilation and 10% for symmetrical ventriculomegaly.

Prenatal progression of the ventriculomegaly (increase of more than 3 mm) is clearly associated with a poor prognosis ($P = 0.02$): 25% of the ventriculomegalies were progressive in group 1 versus 3.3% in the remainder of the population.

Sixty-five fetuses had nonbilateral asymmetrical and nonprogressive IMV of lower than 12 mm, and 93.8% of them had completely normal psychomotor development.

Discussion

The absence of an associated anomaly appears to determine the prognosis of ventricular brain enlargement,[1,2,8,9] but the diagnosis of isolated ventriculomegaly should be made only after having carried out a complete and rigorous ultrasound search for associated intracerebral or extracerebral anomalies. It is essential to repeat the ultrasonographic examinations because associated malformations can be detected later during the pregnancy. In a review of 234 cases of IMV,[7] associated anomalies were discovered during the ultrasound follow up in 8.6% of the cases. Ultrasound can also be used to follow the clinical course of ventricular enlargement. In most cases without associated anomaly, ventriculomegaly regresses or remains stable.[2,5,9] Other investigations are essential for the prenatal diagnosis of IMV. Amniocentesis is the easiest method of determining a fetal karyotype and at the same time allows culture of the amniotic fluid for viral screening. In the event of initially isolated ventriculomegaly, the chromosomal anomaly rate appears low (about 4%) but cannot be ignored.[5,9]

Table 6. TOP proposals

	Anomalies revealed by amniocentesis	Associated anomalies diagnosed by ultrasound	MRI anomalies	Evolution	Final diagnosis
1	47 XY + 21		Not performed	Stability	Down syndrome
2	47 XY + 21			Stability	Down syndrome
3	47 XXY		Not performed	Progression	Klinefelter syndrome
4	CMV	Intrauterine growth restriction	Gyration delay	Progression	CMV infection
5	CMV	Subependymal haemorrhage	Germinolysis	Progression	CMV infection
6	GM1 gangliosidosis	Polymalformative syndrome		Progression	Gangliosidose
7		Vertebral malformation		Regression	Ventriculomegaly with vertebral malformation
8			Heterotopia	Stability	Heterotopia
9			Heterotopia	Stability	Heterotopia
10			Heterotopia	Stability	Heterotopia
11			Heterotopia	Stability	Heterotopia
12		Third ventricle enlargement	Third ventricle enlargement	Progression	Stenosis of the aqueduct of sylvius
13		Femur under the 10th percentile	Third ventricle enlargement	Progression	Stenosis of the aqueduct of sylvius
14			Third ventricle enlargement	Progression	Stenosis of the aqueduct of sylvius
15			Septum pellucidum destruction	Stability	Stenosis of the aqueduct of sylvius
16		Intrauterine growth restriction	Septum pellucidum destruction	Progression	Severe ventriculomegaly and septum pellucidum destruction
17		Agenesis of the corpus callosum	Partial agenesis of the corpus callosum and left temporal lobe	Regression	Polymalformative syndrome
18		Agenesis of the corpus callosum	Partial agenesis of the corpus callosum	Stability	Partial agenesis of the corpus callosum
19		Polymalformative syndrome		Progression	Polymalformative syndrome
20		Third ventricle enlargement	Not performed	Progression	Stenosis of the aqueduct of sylvius
21		Third ventricle enlargement	Not performed	Progression	Stenosis of the aqueduct of sylvius

Fetal MRI provides more precise information on the cerebral parenchyma and the posterior fossa. In fact, the ultrasonographic examination is often made difficult by technical factors that obscure features of the brain close to the probe and hinder examination of the posterior fossa at the end of pregnancy. Atrial width can be determined by MRI, whatever the position of the fetal head and the ventricle considered. MRI allows the study of cerebral biometrics and can show gyration or myelination disorders and ischaemic lesions.

In this series of 167 IMV cases, ultrasonographic monitoring detected associated anomalies in 28 cases (16.8%), ten were cerebral or vertebral anomalies with bad prognosis. MRI highlighted brain anomalies in 15 fetuses, 73.3% of which had not been diagnosed by ultrasound; this justifies the use of fetal MRI in spite of its complexity and its cost. In most cases, these associated anomalies resulted in discussion about TOP. Analysis of TOP requests showed that female sex is indisputably a poor prognostic factor, as seen in other studies. In a retrospective study,[7] developmental delay was seen in 22.6% of female fetuses versus 4.6% of male fetuses. Patel *et al.*[10] reported that 50% of girls with fetal IMV had normal development compared with 78% of boys. Ventricular asymmetry, with a difference of more than 2 mm between the two atrial widths,[24] seems indicative of a poor outcome in cases of bilateral distension. This result has not been reported previously. In a review of 366 cases of IMV,[5] 97% of the children had normal development in the event of unilateral ventriculomegaly versus 89.6% in the event of bilateral enlargement. Other studies gave similar results, with more than 90% of normal children in the case of unilateral IMV.[11–13,25,26] Atrial width determines prognosis. Studies of ventricular size in the prognosis of IMV have shown that neurological outcome correlates closely with the degree of enlargement.[14,15,27] When ventriculomegaly is isolated and mild, prognosis seems to depend on the clinical course of atrial enlargement. Goldstein *et al.*[2] found that the increase in size of cerebral ventricles is more often associated with other anomalies. In a retrospective study of 105 cases of IMV,[17] the clinical course of ventriculomegaly correlated closely with the prognosis. In the event of nonprogressive IMV, the prognosis seems to be better and more than 80% of fetuses will have a normal development. The prognosis is still better if ventricular enlargement is resolved during the prenatal period.[3,5,16,17]

This study highlights the importance of rigorous prenatal follow up for ventriculomegaly even if it is initially considered

Table 7. Children with neurological disease

	Sex	Age (months)	Postnatal follow up	Gestational age at birth (weeks)	Results of the prenatal explorations	Postnatal outcome
1	Male	96	Protocol	39	Unilateral, mild and regressive ventriculomegaly	Periventricular leucomalacia, encephalopathy with severe mental retardation
2	Female	23	Questionnaire	35	Bilateral symmetric, mild and stable ventriculomegaly	Encephalopathy with severe mental retardation
3	Female	73	Protocol	40	Bilateral symmetric, mild and stable ventriculomegaly	Heterotopia, psychomotor delay
4	Male	51	Protocol	39	Bilateral asymmetric, mild and progressive ventriculomegaly	Triventricular hydrocephalus, stenosis of the aqueduct of sylvius, epilepsy
5	Male	43	Protocol	40	Bilateral asymmetric, mild and stable ventriculomegaly	Pervasive developmental disorders
6	Female	127	Questionnaire	36	Bilateral symmetric, mild and regressive ventriculomegaly	Dyslexia
7	Male	79	Questionnaire	33	Unilateral, mild and stable ventriculomegaly	Language delay
8	Male	85	Questionnaire	38	Bilateral asymmetric, mild and stable ventriculomegaly,	Language delay
9	Male	30	Paediatric files	40	Unilateral, mild and stable ventriculomegaly	Periventricular white matter hypersignal, stepping asymmetry
10	Female	25	Protocol	40	Unilateral, mild and progressive ventriculomegaly, third ventricle enlargement at MRI	Upper limb monoparesia
11	Female	53	Protocol	40	Bilateral asymmetric, mild and progressive ventriculomegaly	Periventricular leucomalacia, cerebral palsy
12	Male	80	Questionnaire	40	Bilateral symmetric, mild and regressive ventriculomegaly	Coordination disorders

isolated and mild. It is not unusual for anomalies to appear during follow up, thus highlighting the need for fetal MRI and repeated ultrasound. In addition to the discovery of associated anomalies, the degree of enlargement, its location, and its clinical course seem to influence the prognosis. The parents should be informed of likely outcomes.

On postnatal follow up, 11.88% of the evaluated children had psychomotor delay or neurological disease. Different series looking at IMV have found postnatal developmental delay from 0 to 40% of cases (Table 1). The variation in cognitive outcomes between different studies can be explained by disparities in prenatal diagnostic procedures and in methods of postnatal evaluation. Moreover, few affected children are evaluated at school age. In our study carried out over an 11-year period, a complete and rigorous prenatal assessment was performed in all cases of IMV to screen for associated anomalies. The neurological assessment of the children was carried out by paediatricians and psychologists specialised in this type of disease. To our knowledge, no study of this size mentions such a long postnatal follow up.

Among the 101 children followed up, 89 are regarded as having normal psychomotor development, and 12 developed proven neurological disease ranging from language delay to severe mental retardation.

The results of our study confirm those of the literature, in smaller series, with normal development in an average of 85% of children (Table 1) and confirm the findings of a systematic review published on 577 cases of IMV.[28]

In these cases of prenatal IMV, three prenatal factors seemed to be associated with poor neurological outcome.

First, atrial width, in particular if it is greater than or equal to 12 mm at the time of the initial ultrasound ($P = 0.02$). As in most published studies,[5,7,9,14,15] the degree of enlargement appears to influence the neurological outcome, an atrial width lesser than 12 mm being a sign of good prognosis. For enlargement lesser than 12 mm, 5.9% of the children have a neurological disease versus 24.2% when atrial width is greater than or equal to 12 mm. Similar results were noted by Pilu *et al.*[7] in a review of 234 cases of IMV in which developmental delay was seen in 3.8% of cases for atrial width lesser than 12 mm versus 13.9% if greater than or equal to 12 mm. For Signorelli *et al.*,[23] isolated ventriculomegaly of 10–12 mm might be considered as a variant of normal values.

The second factor is bilateral, asymmetrical ventriculomegaly, which we found to be more often associated with developmental

delay ($P = 0.003$). Fifty percent of asymmetrical and bilateral ventriculomegalies were associated with postnatal neurological disease versus 10% of symmetrical enlargement and 7.5% of unilateral enlargement. Many studies conclude that unilateral ventriculomegaly has a good prognosis,[5,12,13,25,26] but asymmetry does not appear in the published studies as a factor in a worse prognosis.

The third factor is whether the enlargement is progressive ($P = 0.02$). When ventriculomegaly is isolated and mild, the postnatal outcome seems to depend on the clinical course of ventricular enlargement. In the event of nonprogressive IMV, the prognosis seems better and the rate of normal postnatal development is still higher if ventriculomegaly resolves antenatally: normal development was noted in 90% of cases by Kelly *et al.*[5] and in 86% by Mahony *et al.*[16] who reported that stable or progressive IMV was associated with 70% of the deaths or cases of developmental delay.

In our study, 65 fetuses had nonbilateral asymmetrical and nonprogressive IMV with an atrial width less than 12 mm. Postnatally, 6.2% of these children have developmental delay and 93.8% have completely normal psychomotor development.

In this series, the postnatal studies have some limitations. First, 45 of the 146 born children were not followed postnatally, and we have no news about their psychomotor development. But there are no differences in the antenatal characteristics between the children assessed and included in the analysis and the children for which we have no news. Second, there is heterogeneity in the follow-up methods. Indeed, only half of the children could be assessed prospectively with our follow-up protocol. This follow-up programme for prenatal isolated ventriculomegaly was initiated in 1999 by our neurologists and has a high rate of follow up. But for all the children born before 1999, the psychomotor assessment was carried out differently; for the children not followed up in our neurological assessment protocol, we decided to contact the families by mail with a questionnaire and an appointment for a medical consultation with our neurologist. Some of the children could be evaluated with a questionnaire and their paediatrician was contacted by phone, and some of these children consulted our neurologist. Unfortunately, some parents did not wish to bring their children to the consultation saying that they were in good health, and others did not want to answer us. However, the answers to the questionnaire were analysed by our paediatricians and were considered sufficient for the postnatal evaluation.

Conclusion

Ventriculomegaly is the cerebral anomaly most often diagnosed in the fetus but is still incompletely understood. The detection of isolated, mild fetal ventriculomegaly raises the possibility of long-term problems with psychomotor development and justifies meticulous and detailed prenatal investigation to search for associated anomalies.

In this study of 167 cases of IMV, we identified three criteria that increased the chance of an unfavourable outcome: atrial width greater than 12 mm, progression of the enlargement, and asymmetrical, bilateral ventriculomegaly. In the absence of these three criteria, the cognitive outcome seems to be reassuring, with more than 93% of born children having normal development. ■

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