Incidence and Predictors of CSF Diversion for Children Prenatally Diagnosed with Ventriculomegaly on Fetal MRI

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Introduction

Fetal magnetic resonance image (MRI) is more frequently employed to assess structural anomalies seen on ultrasonography. Fetal ventriculomegaly (FVM) is one of the most common central nervous system abnormalities diagnosed at around 22-24 weeks of gestational age[1], and a common condition for pediatric neurosurgical referral. FVM is determined by measuring the atrial diameter (AD), which remains stable after 15 weeks gestational age.[2] An AD ≥ 10 mm in any stage of pregnancy is considered ventriculomegaly, which is defined as mild (10 to 12 mm), moderate (13 to 15 mm), or severe (> 15 mm).[3,4] More than 40% of mild FVM cases resolve in utero when no other congenital anomalies are present.[5] Specifically for isolated, mild cases of FVM, 93% of children have normal neurologic development.[6] Studies on FVM have shown that an AD greater than 20 mm is strongly associated with the need for cerebral spinal fluid (CSF) diversion.[7]

Further understanding into the prevalence of FVM is important. Evaluating the demographic, clinical and fetal radiographic features predictive of postnatal CSF diversion would help with pregnancy counseling and postnatal management.

Methods

We performed a single-center retrospective review of fetal MRIs performed at Nicklaus Children's Hospital (Miami, Florida) between January 2012 and December 2020. Nicklaus Children's Hospital is a highly specialized neurosurgical referral center with a well-organized and comprehensive Fetal Care team. Inclusion criteria for this study were the following:

- Infants with prenatal MRI which demonstrated fetal ventriculomegaly;
- Maternal prenatal consultation with a pediatric neurosurgeon; and
- At least one postnatal pediatric neurosurgical assessment

Results

Table 1. Predictors of CSF diversion (n=11) for infants with various demographic and radiographic features

Variable	Univariate analysis		Multivariate analysis	
	OR	p-values	OR	p-values
Male gender	0.83	0.77		
Gestational age at MRI	0.98	0.66		
Gestational age at birth	1.02	0.88		
Intraventricular hemorrhage	3.05	0.92		
Dandy-Walker complex	0.35	0.24		
Aqueductal stenosis	22.67	0.014*		
Septum pellucidum abnormality	8.31	0.002*		
Corpus callosum agenesis or thinning	12.05	0.002*	9.64	0.049*
Severity of ventriculomegaly	6.40	< 0.001*	33.34	0.003*
Myelomeningocele	16.33	< 0.001*	2769.04	0.006*

Conclusion

FVM is the most common fetal abnormality which led to prenatal neurosurgical intervention and post-natal follow-up. Of 114 maternal-fetal pairs with a fetal diagnosis of CNS anomaly, 65 infants (57.0%) demonstrated prenatal features of ventriculomegaly. Of the 65 infants, 11 patients (16.9%) required CSF diversion in the form of either ETV CPC or VPS following birth. On multivariate analysis, the greatest predictors for postnatal CSF diversion were the severity of ventriculomegaly on fetal MRI, which was frequently associated aqueductal stenosis, disruption of the septum pellucidum, and thinning or dysgenesis of the corpus callosum. The presence of a myelomeningocele independently predicted CSF diversion, regardless of prenatal ventricular size. The presence of intraventricular hemorrhage and Dandy-Walker complex were not associated with CSF diversion.

There is potential selection bias as the analysis does not take into account the infants who were either terminated or which did not require further neurosurgical follow-up. However, the patients that did require neurosurgical intervention had their first surgery on average at 2.3 ± 3.4 months, while the mean follow-up time for the study was 29.9 months. Longer follow-up and standardized neuropsychological testing for these children would reveal more interesting findings.

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