University of Cincinnati

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I, Kyla J Patek , hereby submit this original work as part of the requirements for the degree of Master of Science in Genetic Counseling.

It is entitled:

Posterior fossa anomalies diagnosed with fetal MRI: Associated anomalies and neurodevelopmental outcomes

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**Posterior fossa anomalies diagnosed with fetal MRI: Associated anomalies and
neurodevelopmental outcomes**

A thesis submitted to the
Graduate School of the University of Cincinnati
in partial fulfillment of the requirements
for the degree of
Master of Science

In the Program of Genetic Counseling
of the College of Medicine

By

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on

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Committee Chair: Robert J. Hopkin, M.D.

Abstract

Objective: The purpose of this study was to describe the relationship between intra- and extra-cranial anomalies and neurodevelopmental outcome for fetuses diagnosed with a posterior fossa anomaly (PFA) on fetal MRI.

Methods: Cases of Dandy-Walker malformation (DWM), vermian hypogenesis/hypoplasia (VH), and mega cisterna magna (MCM) were identified through the Fetal Care Center of Cincinnati between January 2004 and December 2010. Parental interview and retrospective chart review were used to assess neurodevelopmental outcome.

Results: PFAs were identified in 59 fetuses; 9 with DWM, 36 with VH, and 14 with MCM. Cases with isolated PFAs (14/59) had better outcomes than those with additional anomalies ($p=0.00016$), with isolated cases of MCM all being neurodevelopmentally typical. Cases with additional intra-cranial anomalies were more likely to have a poor outcome than those without intra-cranial anomalies ($p=0.00085$). The presence of extra-cranial anomalies increased the likelihood of having a poor outcome ($OR=10.2$, 95% CI, 2.6-40) as did the identification of an abnormal brainstem ($OR=12.97$, 95% CI, 2.9-58.0).

Conclusion: Intra- and extra-cranial anomalies were good predictors of neurodevelopmental outcome in this study. The prognosis was poor for individuals with an abnormal brainstem while those with isolated MCM had normal neurodevelopmental outcome.

Key Words: *Posterior fossa anomaly; fetal MRI; neurodevelopmental outcome, Dandy-Walker malformation, vermian hypoplasia, mega cisterna magna*

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Table of Contents

List of Figures and Tables	vi
Introduction	1
Methods	2
Results	4
Discussion	6
Conclusion	9
Bibliography	10
Figures	12
Tables	17
Appendices	21

List of Figures and Tables

Figure 1. Fetal MRI of a Dandy-Walker malformation with an abnormal brainstem at 32 weeks gestation.

Figure 2. Fetal MRI of vermian hypoplasia at 33 weeks gestation.

Figure 3. Fetal MRI of mega cisterna magna at 31 weeks.

Figure 4. Fetal MRI of vermian hypoplasia with a small brainstem at 24 weeks gestation.

Figure 5. Neurodevelopmental outcome for cases with vermian hypogenesis/hypoplasia (VH).

Table 1. Outcome of posterior fossa anomalies.

Table 2. Neurodevelopmental outcome for 6 surviving cases with Dandy-Walker malformation.

Table 3. Neurodevelopmental outcome for 21 surviving cases with vermian hypogenesis/hypoplasia.

Table 4. Neurodevelopmental outcome for 10 cases with mega cisterna magna.

Introduction

Posterior fossa anomalies (PFAs), including Dandy-Walker malformation (DWM), vermian hypogenesis/hypoplasia (VH), and mega cisterna magna (MCM), are found in approximately 1 in every 5,000 live births (Bolduc and Limperopoulos, 2009). The identification of a PFA leads to a thorough ultrasound exam or fetal MRI when available. Fetal MRI provides detailed imaging of the soft tissue of the brain to help differentiate between DWM, VH, and MCM, which have different prognoses (Limperopoulos and du Plessis, 2006, Adamsbaum et al., 2005). Fetuses suspected of having a PFA are at an increased risk for both additional intra- and extra-cranial anomalies. Several studies have reported the importance of the identification of additional anomalies for providing accurate prognoses to families (Cornford and Twining, 1992, Estroff et al., 1992, Ecker et al., 2000).

Neurologic complications and developmental delay are commonly seen in children with PFAs. Many studies have reported the rate of developmental delay in children identified with a PFA ranging from 20-80% depending on the specific anomaly and case series (Klein et al., 2003, Bolduc and Limperopoulos, 2009, Gerszten and Albright, 1995, Ecker et al., 2000, Limperopoulos and du Plessis, 2006). The lack of evidence-based outcome data for fetuses diagnosed with PFAs makes it difficult to provide prognostic information to families receiving a prenatal diagnosis.

The purpose of this study was to describe the relationship between intra- and extra-cranial anomalies and neurodevelopmental outcome for fetuses diagnosed with a posterior fossa anomaly (PFA) on fetal MRI consecutively between January 2004 and December 2010 from a single quaternary care center.

Methods

After receiving Institutional Review Board approval, a retrospective chart review was conducted at the Fetal Care Center of Cincinnati (FCC) at Cincinnati Children's Medical Center. All fetal MRIs were reviewed by a radiologist to assess accuracy of diagnosis and identify additional defects. Postnatal images were reviewed when available. Diagnosis of Dandy-Walker malformation was made in the presence of vermian agenesis/hypogenesis, cystic dilatation of the fourth ventricle and enlarged posterior fossa with elevation of the transverse sinus, tentorium and torcula (Figure 1). Vermian abnormalities were described based on standardized measurements described by Garel (2009) and Robinson *et al* (2001). Vermian hypogenesis was noted if the vermis measured small and the fastigial to declive line was less than a 1:2 ratio. The diagnosis of vermian hypoplasia was verified in the presence of a small vermis with normal foliation (Figure 2). Due to the sample size, vermian hypogenesis and hypoplasia were treated as one group for the purpose of analysis. The brainstem was identified as abnormal if small or irregular in configuration compared to normal brainstem measurement standards for gestational age described by Tilea *et al* (2009) (Figure 4).

Data was collected from medical records (prenatal and postnatal) (Appendix 1) with additional information collected through a voluntary parental phone interview (Appendix 2). Women who were referred to FCC for evaluation but experienced a prenatal or perinatal demise were not contacted for the phone interview but were included in the chart review. Data collected from medical record review and phone surveys included the outcome of the pregnancy (delivery, stillbirth, intrauterine fetal demise or termination), medical history of the pregnancy, postnatal imaging, genetic diagnosis/testing, neurologic abnormalities (i.e. seizures, hyper/hypotonia, respiratory distress, feeding difficulties), developmental milestones and parental assessment of

development. Developmental milestones were obtained from parental report and medical records. Developmental function was estimated as mild, moderate or severe based on guidelines provided in the Denver Developmental Screening Test II or other validated developmental testing recorded in the medical records. For statistical purposes outcome was classified as good if the individual had no neurologic abnormalities or development delay and poor if the individuals had neurologic abnormalities, developmental delay, or died.

Fisher Exact test was employed to examine the association between specific features found on MRI and postnatal outcome. Because there were 4 explanatory variables (isolated PFA, additional intra-cranial anomalies, extra-cranial anomalies, and abnormal brainstem) and multiple comparison tests were performed, Bonferroni correction with $\alpha \leq 0.005$ was used. Fisher Exact test, where $\alpha \leq 0.05$, was used to assess the accuracy of fetal MRI based on gestational age. A proportional odds model was developed to determine the strength of association between fetal brain malformations and outcome. Inclusion of all explanatory variables in the model resulted in statistically insignificant coefficients because of overlap between groups. Odds ratios were estimated for extra-cranial anomalies and abnormal brainstem.

Results

A total of 59 fetuses were diagnosed with a PFA on fetal MRI (Table 1); 9 (15%) had DWM, 36 (61%) had VH and 14 (24%) had MCM. The average gestational age at the time of fetal MRI was 25.6 weeks (± 4.8 weeks). Postnatal brain imaging was available for confirmation in 29 cases, and the original diagnosis was confirmed in 24 of the 29 cases. All 5 unconfirmed cases had VH diagnosed before 24 weeks gestation. For VH, diagnoses made after 24 weeks were significantly more likely to be confirmed compared to those made before 24 weeks ($p=.033$). A genetic abnormality was identified by chromosome analysis or high density microarray in 9 cases (3 with DWM, 5 with VH, and 1 with MCM). All individuals with a genetic abnormality were non-isolated cases.

Of the 9 cases with DWM, 2 were electively terminated and 1 died neonatally. All 6 survivors had developmental and neurologic abnormalities (Table 2). The mean age at the time of the study was 2.3 years old (range: 2 months to 4.5 years). DWM was isolated in 1 case, occurred with only additional extra-cranial anomalies in 1 case, and occurred with both intra- and extra-cranial anomalies in 7 cases.

Vermian abnormalities were identified in 36 cases. Vermian hypogenesis was seen in 4 individuals (cases 5, 15, 18 and 27), while the remaining 32 cases were diagnosed with vermian hypoplasia. Neonatal death occurred in 10 cases, 1 was electively terminated, and 2 were lost to follow up. Additionally, 2 individuals died during the first year of life, leaving 21 cases with postnatal information available (Table 3). Of the 21 living cases, neurodevelopmental outcome varied greatly (Figure 5). Five cases had both additional intra- and extra-cranial anomalies; all had abnormal neurodevelopmental outcome.

Mega cisterna magna was identified in 14 cases. Neurodevelopmental outcome information was available for 10 cases (Table 4) and 4 cases were lost to follow up. The MCM was isolated in 7 cases, all of which had normal neurologic and developmental outcomes. Extra-cranial anomalies were identified in 3 cases with MCM; all 3 had neurologic abnormalities and 2 out of 3 also had developmental delay.

The strength of association between PFAs and neurodevelopmental outcome was examined for 50 of the 59 cases under the following conditions: isolated or when seen in the presence of intra-cranial abnormalities, extra-cranial abnormalities, or an abnormal brainstem. Those lost to follow up (6/59) or terminated (3/59) were excluded. The average age at the time neurodevelopmental outcome was gathered was 2.9 years old (range: 1 month to 6.5 years). Cases with isolated PFAs had statistically better neurodevelopmental outcomes than cases identified with additional anomalies (14/50 and 36/50, respectively; $p=0.00016$). Cases with additional intra-cranial anomalies were more likely to have a poor outcome compared to those without additional intra-cranial anomalies (26/50 and 24/50 respectively; $p=0.00085$). Similarly, the presence of extra-cranial anomalies was associated with a worse outcome compared to those without extra-cranial anomalies (30/50 and 20/50 respectively; $p=0.00014$). The presence of extra-cranial anomalies with a PFA increased the likelihood of having a poor neurodevelopmental outcome or death (OR=10.2, 95% CI, 2.6-40). Brainstem abnormalities were identified in 15 cases (30%); of these, 9 died and 6 have neurologic abnormalities and severe developmental delay. The presence of a brainstem abnormality was related to a significantly worse outcome compared to those with normal brainstems (15/50 and 35/50 respectively; $p=0.00018$) and increased the odds of having a poor neurodevelopmental outcome or death (OR=12.97, 95% CI, 2.9-58.0).

Discussion

Posterior fossa anomalies are a relatively common finding on prenatal ultrasound. The variation in neurodevelopmental outcome seen between different PFAs as well as within each specific anomaly is great, making counseling families receiving this diagnosis challenging. Many studies have reported a relationship between additional intra- and extra-cranial anomalies and neurodevelopmental outcome (Kolble et al., 2000, Ecker et al., 2000, Forzano et al., 2007, Bolduc and Limperopoulos, 2009). In this study, the identification of additional intra-cranial anomalies or extra-cranial anomalies was associated with a worse outcome regardless of the type of PFA. These results support previous studies in emphasizing the importance of a full anatomic scan to establish whether additional intra- or extra-cranial anomalies are present (Levine et al., 1999, Adamsbaum et al., 2005). Additionally, fetal MRI provides detailed information about neuroanatomy and can identify brain anomalies, such as heterotopia or abnormal gyria that could be missed on a level II ultrasound. Considering 20% of cases of DWM, VH, and non-isolated MCM had a chromosome abnormality detected, an amniocentesis with chromosome analysis and high density microarray should be considered in the diagnostic work-up for a fetus identified with a PFA.

Of children who had a poor outcome, the odds that they had a brainstem abnormality were greater than the odds that they had an extra-cranial abnormality. To the knowledge of the authors, a statistical analysis of the relationship between brainstem abnormalities and outcome for individuals with a PFA has not been previously reported in the literature. Although previous studies have not treated brainstem abnormalities as a separate risk factor from other anomalies, our analysis demonstrates that when abnormal, the brainstem is important for predicting neurodevelopmental outcome. All brainstem abnormalities in this study led to a poor outcome,

with a significant number of neonatal deaths. The literature on specific syndromes involving brainstem abnormalities, such as Walker Warburg syndrome, indicates that the outcome is poor when the brainstem is involved (Vajsaar and Schachter, 2006). It therefore is important that families should be given a guarded prognosis when a brainstem abnormality is found in addition to a PFA, regardless of whether additional anomalies or a specific syndrome is identified.

In previous literature, neurodevelopmental delay occurs in 40-60% of children with DWM, with the identification of additional anomalies leading to a worse prognosis (Klein et al., 2003, Boddaert et al., 2003). In this study all but one case had additional intra- and/or extra-cranial anomalies and all living children had hydrocephalus which required a shunt. These findings suggest that a DWM is more likely to be found in the presence of additional anomalies rather than as an isolated occurrence. Similar to previous studies where high rates of additional anomalies were found (Long et al., 2006), all cases of DWM in this study had a poor outcome.

Unlike DWM, classification of vermian abnormalities has changed rapidly in the last ten years leading to difficulties in making meaningful comparison between studies looking at vermian hypoplasia, Dandy-Walker variant, Dandy-Walker continuum, and Dandy-Walker complex. Although there were not enough cases in our study population to perform statistical analysis, there did not appear to be a difference in outcome between cases with vermian hypogenesis versus vermian hypoplasia. Postnatal confirmation of VH was made in 83% of cases, demonstrating that false positive diagnoses can still occur when the fetal MRI is performed before 24 weeks. This is similar to previously reported confirmation rates, and is thought to be due to normal variation in development (Limperopoulos et al., 2006). Many studies have reported a better prognosis for individuals with isolated VH compared to individuals with VH and additional anomalies (Bolduc and Limperopoulos, 2009, Harper, 2007); however,

isolated VH did not have a better prognosis in this study. Despite the insignificance of VH with intra- or extra-cranial anomalies separately, when both were present the outcome was universally poor, with all having either poor neurodevelopmental outcome or death. These findings are similar to a previous report that risk for death increases significantly when additional anomalies are found in two or more organ systems (Salihu et al., 2008).

The question of whether an isolated MCM (≥ 10 mm) is pathogenic or a benign variant in human development has important implications for parents who are considering termination. This study adds to the current literature which is consistent with a normal neurodevelopmental postnatal outcome for fetuses with an isolated MCM (Bolduc and Limperopoulos, 2009, Adamsbaum et al., 2005, Long et al., 2006, Haimovici et al., 1997, Dror et al., 2009, Forzano et al., 2007). Previous reports indicate that non-isolated cases of MCM have good outcomes in 11-29% of cases (Forzano et al., 2007, Long et al., 2006). The non-isolated cases of MCM in this study had a worse outcome than has been reported in the literature, with all having neurologic abnormalities and/or developmental delay. However, this group only included three cases and therefore may not represent the true variation in neurodevelopmental outcome that exists in the larger population.

An important limitation of this study was the lack of standardized evaluation of neurodevelopmental outcome. In a review of studies looking at neurodevelopmental outcome in children with cerebellar malformations, 74% of studies shared this same limitation (Bolduc and Limperopoulos, 2009). Although both parental report and medical records review were utilized to assess neurodevelopmental outcome, it is possible that subtle deficits that have been reported in adult studies could have been missed (Zimmer et al., 2007).

Conclusion

This study includes a large series of fetuses identified with PFAs on fetal MRI. The availability of pediatric follow up information has made it possible to identify several features that correspond with prognosis and may be useful when counseling families receiving this diagnosis. Additional intra- and extra-cranial anomalies are indicative of a worse outcome than isolated PFAs. In the absence of a brainstem abnormality or both intra- and extra-cranial anomalies, the prognosis for VH varies from normal to poor, making counseling families for VH difficult. Additionally, fetal MRI to assess VH before 24 weeks is associated with an increased likelihood of having a false positive result. This may limit the utility for families who are considering termination, as there are gestational age restrictions for termination in most states.

Since having a brainstem abnormality increased the likelihood of having a poor outcome 13-fold, the importance of examining the brainstem to help establish risk for poor outcome should be emphasized. Isolated MCM had a good prognosis, and is likely a normal variant, while the outcome for non-isolated cases of MCM is more guarded. This means that the identification of MCM on ultrasound should prompt providers to evaluate the fetus for additional anomalies in order to provide accurate counseling to families. Although this study is limited because of its retrospective nature, it emphasizes the utility of fetal MRI to characterize the brain and identify additional anomalies when a PFA is suspected. Prospective studies using standardized outcome measures in a number of functional domains will be important for identifying specific areas of deficit for individuals diagnosed with a PFA.

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Figure 1 – fetal MRI of a Dandy-Walker malformation with an abnormal brainstem at 32 weeks gestation

Figure 2 – fetal MRI of vermian hypoplasia at 33 weeks gestation

Figure 3 – fetal MRI of mega cisterna magna at 31 weeks gestation

Figure 4 – fetal MRI of vermian hypoplasia with a small brainstem at 24 weeks gestation

Figure 5 – Neurodevelopmental outcome for cases with vermian hypogenesis/hypoplasia (VH)

Table 1 – Outcome of posterior fossa anomalies

	Elective termination	Intrauterine/neonatal demise	Neonatal survivors		
			Normal	Abnormal	Lost to follow up
DWM (n=9)	2	1	0	6	0
VH (n=36)	1	10	7	16 ^a	2
MCM (n=14)	0	0	7	3	4

^aTwo died within the first year of life

Table 2 – Neurodevelopmental outcome for 6 surviving cases with Dandy-Walker malformation

Case #	Isolated	Other findings	GA (wk.)	Sex	Neurodevelopmental data	Age at time of study (mo.)
10	No	VM, VSD, spastic dysplasia	26 4/7	Female	Severe DD ² , hypotonic, respiratory distress, obstructive sleep apnea, Shunt needed to treat hydrocephalus	55
11	No	Abnormal brainstem, abnormal corpus callosum, absent septum pellucidum, congenital scoliosis, dysmorphic facies, hearing loss 46XX, del(3)(q24q25.3)	37 2/7	Female	Severe DD ² , hypertonic, feeding difficulties, failure to thrive (<3%), respiratory distress. Shunt needed to treat hydrocephalus	42
12	No	Congenital diaphragmatic hernia, microgastria, plagiocephaly, dysmorphic features 46XY, dup(11)(p13)	38	Male	Severe DD ¹ , feeding difficulties, respiratory distress, Shunt needed to treat hydrocephalus	31
14	No	Small wavy brainstem, abnormal corpus callosum, lissencephaly, cleft lip, unilateral microphthalmia, unilateral congenital cataracts and glaucoma Muscle eye brain disease	34 2/7	Male	Severe DD ¹ , feeding difficulties, complex partial epilepsy, respiratory distress, Shunt needed to treat hydrocephalus	33
16	No	Hypoplastic brainstem, absent septum pellucidum, abnormal corpus callosum, unilateral renal agenesis, congenital hip dysplasia, vertebral anomalies, dysmorphic features, congenital hearing loss, cortical visual impairment	39	Female	Severe DD ¹ , hypotonic, feeding difficulties, seizures, respiratory distress, Shunt needed to treat hydrocephalus	7
17	No	Absent septum pellucidum, abnormal corpus callosum, bilateral club feet, micrognathia, upgaze palsy	39	Male	³ Hypertonic, respiratory distress, Shunt needed to treat hydrocephalus*	2

¹Development based on milestones achieved; ²Development based on healthcare provider report; ³Unable to assess development based on age

DD, developmental delay; VM, ventriculomegaly; VSD, ventricular septal defect

Table 3 – Neurodevelopmental outcome for 21 surviving cases with vermian hypogenesis/hypoplasia

Case #	Isolated	Other findings	GA (wk.)	Sex	Neurodevelopmental data	Age at time of study (mo.)
5	No	Bilateral cortical heterotopia, thin corpus callosum, gray matter heterotopia, congenital head tilt, dysmorphic features, stereotypic movement disorder	38 5/7	Female	Moderate DD ² , hypotonic	68
15	No	Microcephaly, bilateral inguinal hernia, laryngomalacia, dysmorphic features, 46XY, dup(1)(q43)	38 6/7	Male	Moderate DD ² , spastic quadriplegia, epilepsy, feeding difficulties, sleep apnea, profound hearing loss	23
18	Yes		34	Male	Mild DD ¹ , seizures	66
27	No	Occipital cephalocele	36 6/7	Male	Normal development ¹ , shunt required	15
4	Yes		34	Female	Normal development ¹	79
6	No	Abnormal brainstem, aqueductal stenosis, agenesis of the corpus callosum, absent septum pellucidum, septo-optic dysplasia, choanal stenosis, Pierre-Robin sequence, dysmorphic features, abnormally shaped teeth, 46XY, del(9)(p11.2)	38 5/7	Male	Severe DD ¹ , hypotonic, cerebral palsy, tachycardia, hypoventilation syndrome, feeding difficulties, shunt required	64
7	No	Rectoperineal fistula, umbilical hernia, laryngomalacia, hydronephrosis, patchy hyperpigmentation, dysmorphic features	37 2/7	Female	Mild DD ² , feeding and respiratory distress	56
8	No	Tetralogy of Fallot	38	Female	Normal development ¹	53
9	No	Absent septum pellucidum	36 2/7	Female	Normal development ¹	35
19	Yes		38 1/7	Male	Normal development ¹	60
20	No	Hypospadias, ASD, VSD	35 5/7	Male	Normal development ²	57
21	No	Absent corpus callosum, abnormal septum pellucidum, arthrogyposis	31	Male	Seizures, unknown developmental status	52
13	No	Abnormal corpus callosum, sickle cell disease	39 3/7	Female	Normal development ²	31
23	Yes	Twin pregnancy	33	Male	Apnea, unknown developmental status	28
35	No	Brainstem abnormality	39	Female	Poor suck, feeding difficulties	1
25	Yes	Mild hearing loss	40	Male	Moderate DD ¹	26
26	No	Coarctation of the aorta, hypospadias, cryptorchidism, dysmorphic features	31 6/7	Male	Mild DD ¹ , Hypertonic, apnea, seizures, feeding difficulties	21
54	No	Partial absence of the septum pellucidum, septo optic dysplasia, upbeat nystagmus, scoliosis	35	Male	Severe DD ¹ , epilepsy, feeding difficulties, respiratory distress, shunt required	50
55	No	Duodenal atresia, left sided Erb's Palsy	35	Female	Hypotonic, feeding difficulties, unknown developmental status	44
60	No	Abnormal brainstem, abnormal corpus callosum, horizontal nystagmus	33	Male	Severe DD ² , seizures, feeding difficulties and respiratory distress	3
61	No	Cleft lip, coarctation of aorta, VSD, cryptorchidism, dysmorphic features, 46XY, del(17)(q25.3)	38 4/7	Male	Moderate DD ² , hypotonic	24

¹Development based on milestones achieved, ²Development based on healthcare provider report

DD, developmental delay; ASD, atrial septal defect; VSD, ventricular septal defect; VM, ventriculomegaly

Table 4 – Neurodevelopmental outcome for 10 cases with mega cisterna magna

Case #	Isolated	Other findings	GA (wk.)	Sex	Neurodevelopmental data	Age at time of study (mo.)
3	No	Ulna shorter than radius, mild dysmorphic features	38 1/7	Female	Moderate DD ¹ , hypotonic, seizures	79
28	Yes		39 4/7	Female	Normal Development ¹	67
29	No	Bilateral hydronephrosis, laryngomalacia, pectus excavatum, dysmorphic features	41	Male	Normal Development ² , feeding difficulties and respiratory distress	62
30	No	Complex 1 deficiency, ASD, cryptorchidism, hypospadias, torticollis	37 1/7	Male	Severe DD ¹	44
31	Yes		38 5/7	Male	Normal Development ¹	40
34	Yes		37	Male	Normal Development ¹	32
36	Yes		36 3/7	Male	Normal Development ²	28
38	Yes		38	Male	Normal Development ²	23
40	Yes		40 3/7	Female	Normal Development ²	17
41	Yes		40 5/7	Male	Normal Development ¹	15

¹Development based on milestones achieved, ²Development based on healthcare provider report

DD, developmental delay; ASD, atrial septal defect

Appendix 1: Medical Chart Abstraction

Posterior Fossa Anomaly Study: Medical chart review

Name _____ DOB _____ MRN _____ DHG _____

Prenatal Chart Review:

G ____ P ____ Age ____ Exposures/Meds _____

Prenatal Maternal Serum Screen Yes ____ No ____

Type _____ Results: _____

Diagnostic Prenatal Testing: Amniocentesis ____ CVS ____

Results: _____

Reason for Referral to Fetal Care Center _____

Date _____ Gestational Age _____

U/S Findings:

Date _____ Gestational Age _____

MRI Findings:

Date _____ Gestational Age _____

CNS:

Vermis:

Extra-CNS:

Diagnosis:

Fetal Care Team Prognosis/Plan

Pregnancy Complications

Pregnancy Outcome

Postnatal Chart Review:

Infant Name _____ DOB _____ MRN _____ DHG _____

Mat age at delivery _____ Pat age at delivery _____

Hospital of delivery _____ Gestational Age _____

Mode of delivery _____

BWt _____ Lt _____ HC _____ Apgars _____

NICU _____ O₂ _____

Postnatal Complications Yes ____ No ____

Head U/S Yes ____ No ____

CT Yes ____ No ____

MRI Findings: Yes ____ No ____

CNS:

Vermis:

Extra-CNS:

Genetics Consultations Yes ____ No ____

Genetic Testing Yes ____ No ____

Other Congenital Anomalies Yes ____ No ____

Dysmorphic Features Yes ____ No ____

Developmental Outcome Information Yes ____ No ____

Milestone Achievement:

Psychological Testing:

Other:

Appendix 2: Posterior Fossa Anomaly Script/Questionnaire

Posterior fossa anomaly phone survey script

Hello, I'm Kyla Patek from Cincinnati Children's Hospital Medical Center Division of Human Genetics and the Fetal Care Center of Cincinnati. Could I speak with Mr. or Mrs. _____?

I am calling on behalf of Christine Spaeth, genetic counselor, Robert Hopkin, M.D., geneticist, and Beth Kline-Fath, M.D., radiologist, who you may recall meeting at the Fetal Care Center.

This phone call is a follow-up to the letter we sent you 1-2 weeks ago. The letter explained the purpose of this research study which is to learn more about the medical and developmental outcomes for babies diagnosed with a posterior fossa anomaly. Did you receive the letter? (If letter was not received, read letter to potential participant.)

Your participation in this research study is completely voluntary and you may withdraw your consent at any time. We would like to ask you some questions about your child's health and developmental progress. We would also like to talk to you about the accuracy of the information provided and your satisfaction level with the counseling you received from the Fetal Care Center. To help us better understand brain abnormalities found on fetal MRI, we would like to review you and your child's medical records at CCHMC. If your child was not seen at Children's, we may ask your permission to obtain some portion of their medical record from another hospital.

Would you like to participate in this study?

If no: Thank you for your time. May we have your permission to include your Fetal Care Center records in our study? As discussed in the letter, all efforts will be made to make sure these records are kept confidential.

If yes: Thank you for volunteering to participate in our study. As the letter explained, participating involves taking part in a brief phone questionnaire. During this interview we will ask you questions on the outcome of your pregnancy, and if appropriate, information about your child's health and developmental progress. We want to know how the information we told you at the Fetal Care Center visit relates with how your child is doing now. Additionally, we want to know what counseling information you wished you had received prenatally.

We would like to schedule a time for us to call you to conduct this interview, or we could do it now if that is convenient. When would be a good time for you?

If now: Proceed to questionnaire

If future date: We look forward to talking with you soon. Thank you.

Posterior Fossa Anomaly questionnaire**MRN:****Date:**

First, I'd like to start by getting some information about the remainder of the pregnancy.

1. At how many weeks gestation was your baby born?
_____ Weeks
2. Is your child still living?
Yes _____ No _____
3. Is your baby a boy or girl?
Boy Name _____
Girl Name _____
4. What is his/her date of birth?
____/____/____
5. At what hospital was your baby born?

6. Did your baby have hydrocephalus (water on the brain) at birth?
Yes
No
7. Did your baby have a brain MRI in the newborn period?
Yes
No
8. Did the MRI show a _____ (insert patient specific FCC diagnosed PFA)?
Yes
No
Other MRI findings

9. Did your baby need a shunt?
Yes
No
10. What treatment did your baby receive for the hydrocephalus?
Ventriculoperitoneal (VP shunt)
Cystoperitoneal shunt
Ventriculocystoperitoneal shunt
Cyst Wall fenestration
11. Did your baby have any other birth defects that he/she was born with?

Heart
Lungs
Digestive tract
Kidneys
Spine
Arms or legs
Fingers or toes
Head and neck

12. Has your child been diagnosed with a genetic syndrome or specific condition?

Yes. Syndrome _____

No

13. Has he/she had any genetic testing?

14. Please list any other health problems your child has had.

15. Now I want to ask you some questions about your child's development. Please tell me the age when your child was first able to do the following tasks (ask age appropriate questions):

<p>___ 0-6 months</p> <p>Hold bottle to feed self _____</p> <p>Reach for objects _____</p> <p>Imitate speech sounds _____</p> <p>Roll over _____</p> <p>Sit unassisted _____</p>	<p>___ 7-12 months</p> <p>Roll over _____</p> <p>Sit unassisted _____</p> <p>Wave bye-bye _____</p> <p>Drink from a cup _____</p> <p>Use single words _____</p> <p>Stand _____</p> <p>Walk _____</p>
<p>___ 2 + years</p> <p>Roll over _____</p> <p>Sit unassisted _____</p> <p>use single words _____</p> <p>2-3 word phrases _____</p> <p>sentences _____</p> <p>stand _____</p> <p>walk _____</p> <p>run _____</p> <p>understand speech _____</p> <p>Name colors _____</p> <p>Balance on each foot _____</p> <p>Dress self _____</p>	<p>___ 1-2 years</p> <p>Roll over _____</p> <p>Sit unassisted _____</p> <p>Use single words _____</p> <p>Stand _____</p> <p>Walk _____</p> <p>Use spoon/fork _____</p> <p>Take off/put on clothes _____</p> <p>Scribble _____</p> <p>2-3 word phrases _____</p> <p>Run _____</p>

16. At what age level do you feel your child is functioning?

Below age level

Age appropriate

Above age level

17. Has your child needed services such as Help Me Grow, First Steps, or Early Intervention services?

Yes

No

18. Is he/she currently receiving:

Speech Therapy No Yes where? _____

Physical Therapy No Yes where? _____

Occupational Therapy No Yes where? _____

19. Does your child have an Individualized Education Plan (IEP)?

Yes

No

20. What information did the Fetal Care Center give you about the prognosis or what to expect for your child?

21. How well does the outcome predicted by the Fetal Care Center compare to your child's health and developmental outcome?

Exactly

Somewhat

Not at all

Please describe the differences

22. What information do you wish the Fetal Care Center had provided?

23. Do you have any other comments or feedback for us?

We would like to compare the prenatal and postnatal MRI results to look at the accuracy of the prenatal diagnosis.

Will you allow us to obtain your child's MRI results if it was done at a hospital besides Cincinnati Children's?

(If yes) Where can we mail or fax you the CCHMC Release of information form. Once you receive this form, we can go over it by phone if you have questions. After signing it, you can mail it back to us in the stamped addressed envelope which is provided.

Thank you very much for agreeing to participate in this follow-up phone survey from the Fetal Care Center and the Division of Human Genetics at Cincinnati Children's Hospital Medical. Do you have any questions at this point?

Here is the information on the study contact person you may want to write down for your records.

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