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Prenatal Diagnosis of Fetal Aqueductal Stenosis: A Multicenter Prospective Observational Study through the North American Fetal Therapy Network (NAFTNet)

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Author Contributions:

Emery contributed to manuscript conception, data review, manuscript writing, coordination of co-author input, and approval. Lopa performed the statistical analysis, manuscript review, and approval. Peterson, Jelin, Treadwell, Gebb, Galan, Criebaum, Bergh, McLennan, Lillegard, and Blumenfeld contributed to data acquisition and the manuscript review and approval.

Statement of Ethics:

The University of Pittsburgh Institutional Review Board (IRB) approved of the study to be conducted locally (STUDY20050409). Registry approval was obtained through the University of Pittsburgh IRB (STUDY20020214) for the University of Pittsburgh to serve as the coordinating center for the study. Each collaborating center completed their local IRB approval for site enrollment, data extraction, and registry entry. A data use agreement (DUA) was obtained between the University of Pittsburgh and each collaborating center with local IRB approval being a prerequisite of DUA execution. Written informed consent was obtained for participation in the study. Registry data was entered into the database by collaborating centers in a de-identified manner. This study protocol was reviewed and approved by ethics committees at each of the participating sits. The full list of participating sites and ethics committees can be found at https://docs.google.com/document/d/13ss4t9Z13KV-sulmBgsnCvaaaeXtqRQO0DmWbXbwcPk/edit?usp=sharing.

Conflict of Interest Statement:

The authors have no conflicts of interest to declare.

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Abstract

Introduction: A critical component of an evidence-based reassessment of in-utero intervention for fetal aqueductal stenosis (fetal AS) is determining if the prenatal diagnosis can be accurately made at a gestational age amenable to in-utero intervention.

Methods: A multicenter, prospective, observational study was conducted through the North American Fetal Therapy Network (NAFTNet). Pregnancies complicated by severe CNS ventriculomegaly (lateral ventricle diameter >15 mm) not secondary to a primary diagnosis (myelomeningocele, encephalocele, etc.) were recruited at diagnosis. Imaging and laboratory findings were recorded in an online REDCap database. After evaluation, investigators were asked to render their degree of confidence in the diagnosis of fetal AS. The prenatal diagnosis was compared to the postnatal diagnosis obtained through neonatal neuroimaging. Performance characteristics of ultrasound and MRI were calculated, as was the mean gestational age at diagnosis.

Results: Between April 2015 and October 2022, eleven NAFTNet centers contributed 64 subjects with severe fetal CNS ventriculomegaly. Of these, 56 had both prenatal and postnatal diagnoses recorded. Ultrasound revealed 32 fetal AS true positives, 4 false positives, 7 false negatives, and 13 true negatives rendering a sensitivity of 0.82, a specificity of 0.76, a positive predictive value of 0.89, and a negative predictive value of 0.65. The mean gestational age at diagnosis by ultrasound was 25.5 weeks (std +/− 4.7w). The proportion of agreement (true positive + true negative/n) was highest at 24 weeks gestation. For fetal MRI (n=35), the sensitivity for fetal AS was 0.95, specificity was 0.69, positive predictive value was 0.84, and negative predictive value was 0.90. MRI was performed at 25 weeks on average.

Conclusion: The prenatal diagnosis of fetal aqueductal stenosis can be made with accuracy at a gestational age potentially amenable to in-utero intervention. Only 7% of subjects were incorrectly diagnosed prenatally with fetal AS by ultrasound and 11% by MRI. Diagnostic accuracy of fetal AS will likely improve with increased experience.

Keywords

fetal aqueductal stenosis; ventriculomegaly; hydrocephalus; prenatal diagnosis; MRI; ultrasound

Introduction:

Fetal severe central nervous system (CNS) ventriculomegaly (lateral ventricle >15 mm) affects approximately 1 in 1000 pregnancies.[1] Neurologic outcomes are generally poor, including seizure disorder, developmental delay, and ophthalmological abnormalities.[2–6] Ventriculoamniotic shunting for fetal severe ventriculomegaly was attempted in the 1980s

but was abandoned due to a perceived lack of effect. Technological limitations of fetal imaging in the 1980s precluded an accurate fetal aqueductal stenosis (fetal AS) diagnosis. A de facto moratorium was placed on ventriculoamniotic shunting in 1986.[7]

In the intervening decades, there have been dramatic advances in prenatal diagnosis, such as high-resolution transabdominal and transvaginal ultrasound, magnetic resonance imaging (MRI), and next-generation genetic testing such that an accurate diagnosis of fetal AS, either in isolation or in association with other CNS findings such as cerebellar hypoplasia, should be possible. In the realm of contemporary clinical medicine, an accurate diagnosis is pivotal for navigating the current moratorium on in-utero treatment for this condition.

In 2015, Emery and colleagues proposed an evidence-based reassessment of in-utero intervention for fetal AS.[8] A component of their proposed research agenda was determining if fetal AS can be accurately diagnosed using modern prenatal diagnostic technology at a gestational age potentially amenable to in-utero intervention. This study aims to determine: 1) the performance characteristics of ultrasound and magnetic resonance imaging (MRI) in diagnosing fetal AS using a prospective observational study design and 2) the gestational age when fetal AS is diagnosed.

Materials and Methods:

We conducted a multicenter, prospective, observational study through the North American Fetal Therapy Network (NAFTNet). Inclusion criteria were pregnancies complicated by severe CNS ventriculomegaly (VM, lateral ventricle diameter >15 mm) not secondary to a primary diagnosis such as myelomeningocele or encephalocele, and the ability to obtain longitudinal data through pregnancy, delivery, and at 1 and 2 years of age.

Pregnancies in which long-term follow-up was not possible (pregnancy termination) or unlikely (major extracranial diagnosis) were excluded. Subjects with incomplete information regarding a prenatal or postnatal diagnosis or those recruited after 37 weeks were excluded. A REDCap database was constructed that allowed for the acquisition of maternal demographic information, findings at the initial and subsequent ultrasounds, genetic testing results, infection studies, fetal MRI if performed, delivery information, neonatal data (including postnatal diagnosis by neonatal neuroimaging), and neurologic development at ages one and two years. Neonatal neuroimaging, typically by MRI, was the “gold standard” to which the prenatal diagnosis was compared. De-identified data were entered into the database. The University of Pittsburgh served as the coordinating center (University of Pittsburgh IRB-approved STUDY20040214 Coordinating Center for NAFTNet Prenatal Diagnosis of Aqueductal Stenosis). Each study center required IRB approval and a data use agreement with the University of Pittsburgh.

Sonographic findings suggestive of fetal AS were severe CNS ventriculomegaly; symmetry across the midline; frontal, parietal, and occipital cortical thinning; dangling choroids; dilated third ventricle; and a normal posterior fossa (Fig. 1a-f, Ultrasound findings in fetal AS). MRI findings suggestive of fetal AS were similar to ultrasound findings, plus loss of

extra-axial space and absence of the aqueduct of Sylvius between the 3rd and 4th ventricles (Fig. 2a-b, MRI findings in fetal AS).

At the initial ultrasound diagnosis of apparently isolated severe VM, specific intracranial (ventricular diameter, parenchymal thickness, dangling choroid, third ventricle diameter, posterior fossa) and extracranial (biometry, extracranial anomalies) findings were recorded in the REDCap database. At the end of the data entry tool, co-investigators were asked to rate their degree of confidence in a true positive or a true negative diagnosis of fetal AS. A score of 1 signified that the investigator was confident of a true positive (ultrasound findings consistent with fetal AS). In contrast a score of 6 signified a confident true negative (findings not consistent with fetal AS). A score of 2 signified "probably" fetal AS. A score of 3 signified "possibly" fetal AS (insufficient data to decide). A score of 4 signified "uncertain" (conflicting data). A score of 5 signified that the diagnosis was "probably not" fetal AS. An example of a score of 3 would be symmetric severe ventriculomegaly, dangling choroid, a normal posterior fossa, but a borderline third ventricle. An example of a score of 4 would be a dilated third ventricle and normal posterior fossa but asymmetric ventriculomegaly. Scores 1 and 2 were considered a "Yes" diagnosis of fetal AS. Scores of 5 and 6 were considered a "No" diagnosis. The gestational age of a "Yes" or "No" diagnosis was recorded. For scores of 3 and 4, the process was repeated on subsequent ultrasounds until a "Yes" or "No" diagnosis could be arrived at. If by the end of the pregnancy, a decision was not made, these subjects were treated as a "No" diagnosis (i.e., not "Yes") in the final analysis.

If fetal MRI was performed as part of routine patient care, investigators were asked to enter subjective findings such as symmetry, cortical thinning, loss of extra-axial space (the CSF-filled space between the cortex and the skull), and absence of the aqueduct of Sylvius between the 3rd and 4th ventricles into REDCap. At the end of the data entry tool, investigators were asked whether MRI supports or refutes the diagnosis of fetal AS. The gestational age of the MRI was recorded.

The prenatal diagnosis by ultrasound and MRI, if performed, was compared to the postnatal diagnosis. Using postnatal neuroimaging as the gold standard, we calculated the performance characteristics (sensitivity, specificity, positive predictive value, negative predictive value) of both prenatal ultrasound and MRI. We used McNemar's test to compare the sensitivity of MRI to that of ultrasound among the subjects with both tests. Finally, we calculated the proportion of agreement, or ratio of true positives plus true negatives divided by the total number, across gestation for ultrasound and MRI.

Results:

The study enrolled participants from April 2015 through October 2022. Eleven NAFTNet centers submitted data from a total of 64 subjects. Six were excluded due to a lack of a prenatal diagnosis, postnatal diagnosis, or both. One subject was recruited at >37 weeks gestation and was considered uninformative. One pregnancy ended as a fetal demise.

Therefore, fifty-six subjects with severe CNS ventriculomegaly were available for analysis (Fig. 3, Flow diagram). Table 1 summarizes subject demographics. The mean subject age was 29.3 years, ranging from 19–41 years. A majority were Caucasian. The mean year of pregnancy was 2019, with a median of 2020 and a mode of 2021.

Of the 56 subjects, ultrasound identified 32 with a prenatal diagnosis of fetal AS that matched the postnatal diagnosis of fetal AS (true positive) by neonatal neuroimaging (98% by MRI, 2% by ultrasound). Thirteen subjects were correctly identified as true negatives. Seven subjects were incorrectly diagnosed as not having fetal AS (false negative), and four were incorrectly diagnosed as fetal AS (false positive). The performance characteristics of ultrasound in diagnosing fetal AS among those with severe ventriculomegaly were as follows: sensitivity = 0.82, specificity = 0.76, positive predictive value = 0.89, and negative predictive value = 0.65 (Fig. 4, Ultrasound Performance Characteristics) (Table 2).

The mean gestational age at diagnosis of fetal AS by ultrasound was 25.5 (std +/− 4.7) weeks.

For ultrasound, the proportion of agreement was highest at approximately 24 weeks, indicating that the proportion of true positives and true negatives (i.e., accuracy) is highest then (Fig. 5, Ultrasound proportion of agreement by gestational age).

Of the 56 subjects, 35 (63%) underwent prenatal MRI as part of their clinical care. Twenty-one had an MRI diagnosis of fetal AS that matched the postnatal diagnosis (true positives), 9 were true negatives, one was a false negative, and 4 were false positives, rendering a sensitivity of 0.95, a specificity of 0.69, a positive predictive value of 0.84, and a negative predictive value of 0.90 (Fig. 6, MRI performance characteristics) (Table 2).

MRI was performed at an average gestational age of 24.8 (std +/− 4.8) weeks. MRI was performed before the ultrasound diagnosis of fetal AS (“Yes” or “No”) was made in 12 subjects, suggesting that MRI may have supplemented the ultrasound diagnosis, whereas it was performed after the ultrasound diagnosis in 14 subjects. The proportion of agreement for MRI was 0.86 (Fig. 7, MRI proportion of agreement by gestational age).

Thirty-nine subjects (70%) underwent genetic screening or testing. Fifteen underwent cell-free fetal DNA testing. Twenty-four had amniocentesis for karyotype (n=10), microarray (n=21), whole exome sequencing (n=1), and L1CAM (n=1). Results were normal in 31 subjects (79%), abnormal (microdeletion) in 1 (3%), and “other” (variant of undetermined significance, low fetal fraction) in 7 (18%).

Thirty subjects (54%) underwent screening or testing for infectious agents. Twenty-six underwent maternal serology studies (87%), and 6 underwent amniocentesis (20%). No infectious agents were identified in any of the 30 subjects.

Nine fetuses had extraaxial anomalies, including urogenital anomalies in four (cross renal ectopy (1), horseshoe kidney (1), and urinary tract dilation (2); imperforate anus in three; musculoskeletal anomalies in two (spine (2) and rib (1) abnormalities); and craniofacial anomalies in two (anophthalmia, abnormal left ear).

Conclusion:

Fetal aqueductal stenosis results in severe CNS ventriculomegaly secondary to an accumulation of CSF within the obstructed ventricular system proximal to the aqueduct of Sylvius. Supratentorial intracranial hypertension results in brain tissue ischemia, mechanical axonal shear, and gliosis.[9] Because of its associated poor neurologic outcomes, prenatal shunting for fetal AS was attempted in the 1980s. Limitations of obstetric imaging at the time, however, precluded an accurate diagnosis of fetal AS. Many fetuses with other causes of severe ventriculomegaly, such as hydranencephaly, holoprosencephaly, and Dandy-Walker malformation, who could not benefit from prenatal intervention, were shunted. Additionally, genetic causes of severe ventriculomegaly, such as L1CAM mutation (aka “x-linked hydrocephalus”), were not yet identified and were included in the treatment cohort. A post hoc analysis of an international registry found no benefit for shunting, likely because the data within was biased toward no benefit or adverse effect. Nonetheless, a moratorium on in-utero shunting for fetal severe ventriculomegaly was placed in 1986 by the International Fetal Medicine and Surgery Society (IFMSS) and remains in effect to this day.[7, 8]

Therefore, a critical step in the evidence-based reassessment of in-utero intervention for fetal AS is demonstrating the ability to make an accurate prenatal diagnosis. Using a multicenter prospective methodology, we have demonstrated that an accurate diagnosis can be made at a gestational age potentially amenable to in-utero intervention. Only 4 of 56 subjects (7%) were incorrectly diagnosed with fetal AS by ultrasound for a positive predictive value of 0.89 at a mean gestational age of 25.5 weeks. For MRI, 4 of 35 subjects (11%) were incorrectly diagnosed with fetal AS for a positive predictive value of 0.84 at a mean gestational age of 25 weeks. It is likely that, with increasing familiarity with the diagnosis, performance characteristics will improve over time. From Table 2 and Figures 5 and 7, we observed that fetal AS could be accurately diagnosed as early as 19 weeks gestation. Finally, since the inception of this protocol, there have been several publications on the use of transvaginal ultrasound to evaluate the association between the fetal third ventricle intrathalamic adhesion diameter and dilation of the supra-pineal recesses and obstructive hydrocephalus from fetal AS demonstrating a strong correlation, which could improve the accuracy of diagnosis moving forward.[10, 11]

High-resolution ultrasound was the primary diagnostic tool in this study population, with all subjects undergoing at least one examination. MRI is a helpful adjuvant tool with similar performance characteristics and gestational age at diagnosis of fetal AS. Additionally, because of greater tissue differentiation, MRI holds the potential to identify additional brain findings.[12] We used McNemar’s test to compare the sensitivity of MRI to that of ultrasound among the subset of subjects with both tests. The sensitivity of MRI in this subgroup was 0.95 compared to 0.82 using ultrasound ($p = 0.25$), indicating the two forms of diagnosis did not differ significantly. However, this could be due to a small sample size. Additionally, as previously mentioned, prenatal MRI performed on subjects before ultrasound may have influenced the ultrasound interpretation. The incidence of genetic or infectious diseases was low in our population, likely from small numbers. It is also possible

that many of these affected pregnancies were terminated and, therefore, not recruited into the study.

Using a retrospective methodology, Emery and colleagues correctly diagnosed all cases of fetal AS in 164 fetuses with severe CNS ventriculomegaly[13]. Though encouraging, a single-center, retrospective study is likely insufficient evidence of the accuracy of diagnosis in the real world, and a prospective study is required. Nonetheless, advances in fetal imaging (high-resolution ultrasound, MRI) and next-generation genetic testing suggest that accurate prospective prenatal diagnosis is possible.

A strength of this study is its multicenter prospective methodology and standardized imaging measurements through NAFTNet, whose member centers have experience in prenatal diagnosis[14]. After the initial approval in 2015, the NAFTNet Steering Committee was updated twice annually on the protocol and its progress. Being a prospective study, the prenatal diagnosis preceded the postnatal diagnosis as will occur in clinical practice. As an observational study, there were no requirements on the training level of sonographers, maternal-fetal medicine physicians, radiologists, or ultrasound or MRI equipment for participation in the study, though all participating centers are tertiary referral centers. Centers were asked to care for patients in their usual fashion, thus demonstrating a "real world" assessment of performance. A limitation is the relatively small number of study subjects, consistent with the condition's rarity. Another limitation is the number of incomplete records within the database which precluded a prenatal diagnosis. Finally, as a prospective observational study, some of the ultrasound and MRI findings were subjective. Lacking detailed MRI protocols, some technical methods, such as slice thickness and section plane, were unsuitable for diagnosing an absent aqueduct between the third and fourth ventricles. A manuscript using this data set that correlates prenatal ultrasound and MRI findings with an accurate diagnosis of fetal AS such that a scoring system can be developed is underway. This scoring system may help identify fetuses most likely to benefit from in-utero shunting.

We have demonstrated that fetal AS can be accurately diagnosed as early as 19 weeks gestation (Table 2). This should allow ample time for a thorough evaluation (confirming isolated fetal AS, documenting progression) in preparation for a potential fetal intervention.

In-utero intervention for fetal AS by a purpose-designed ventriculoamniotic shunt and endoscopic third ventriculostomy (ETV) is being investigated in a large animal model. If a benefit is documented in the animal model, demonstrating the ability to make an accurate prenatal diagnosis of fetal AS is required before translation to humans. [9, 15–18]

In conclusion, we demonstrate that fetal aqueductal stenosis can be diagnosed with a reasonable degree of accuracy at a gestational age that may allow for timely in-utero intervention. Furthermore, we anticipate that both performance characteristics and gestational age at diagnosis will improve with increased familiarity with the diagnosis of fetal AS.

Funding Source:

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Data Availability Statement:

The data that support the findings of this study are not publicly available due to concerns for subject confidentiality but are available from SPE upon reasonable request.

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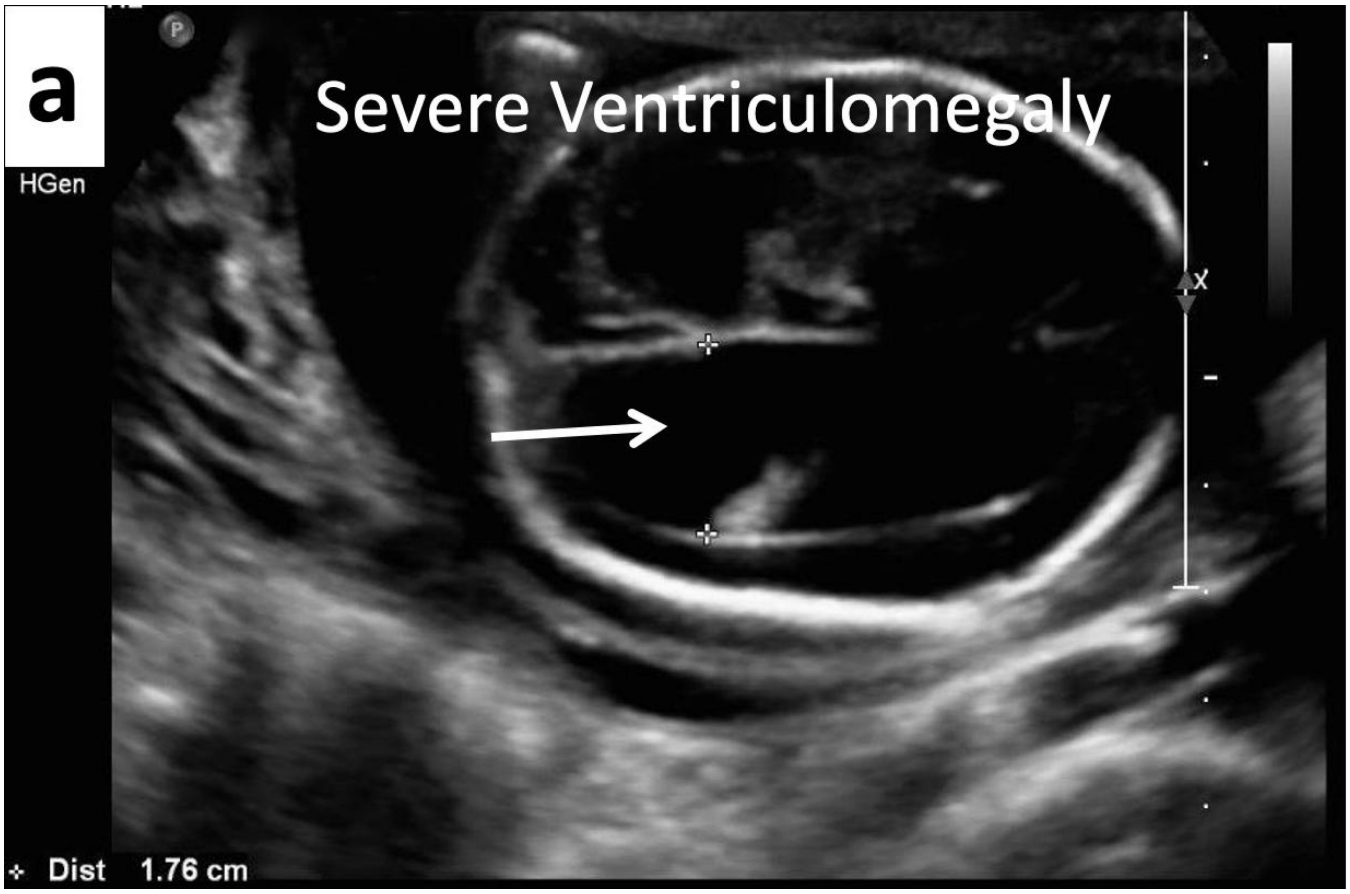
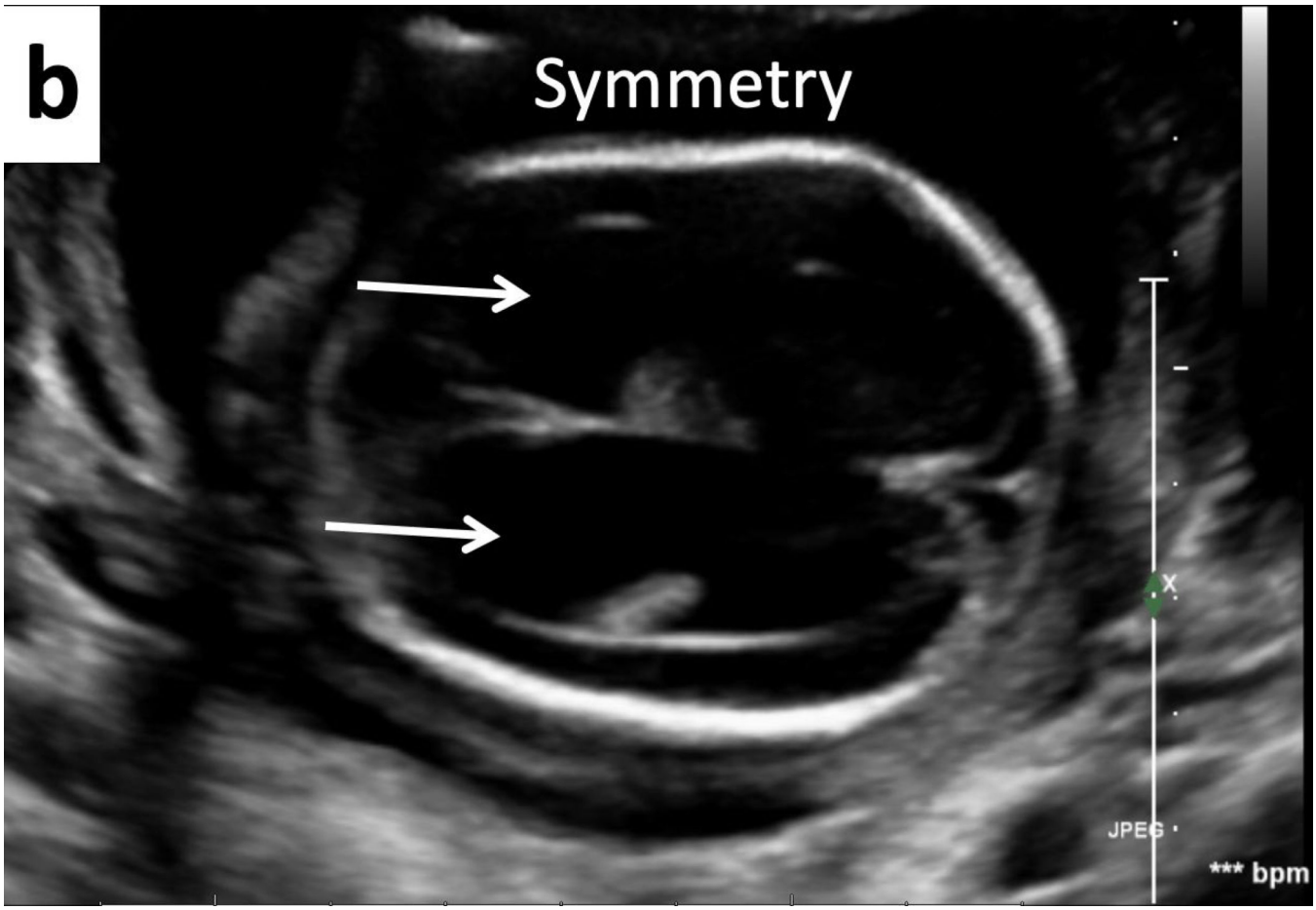
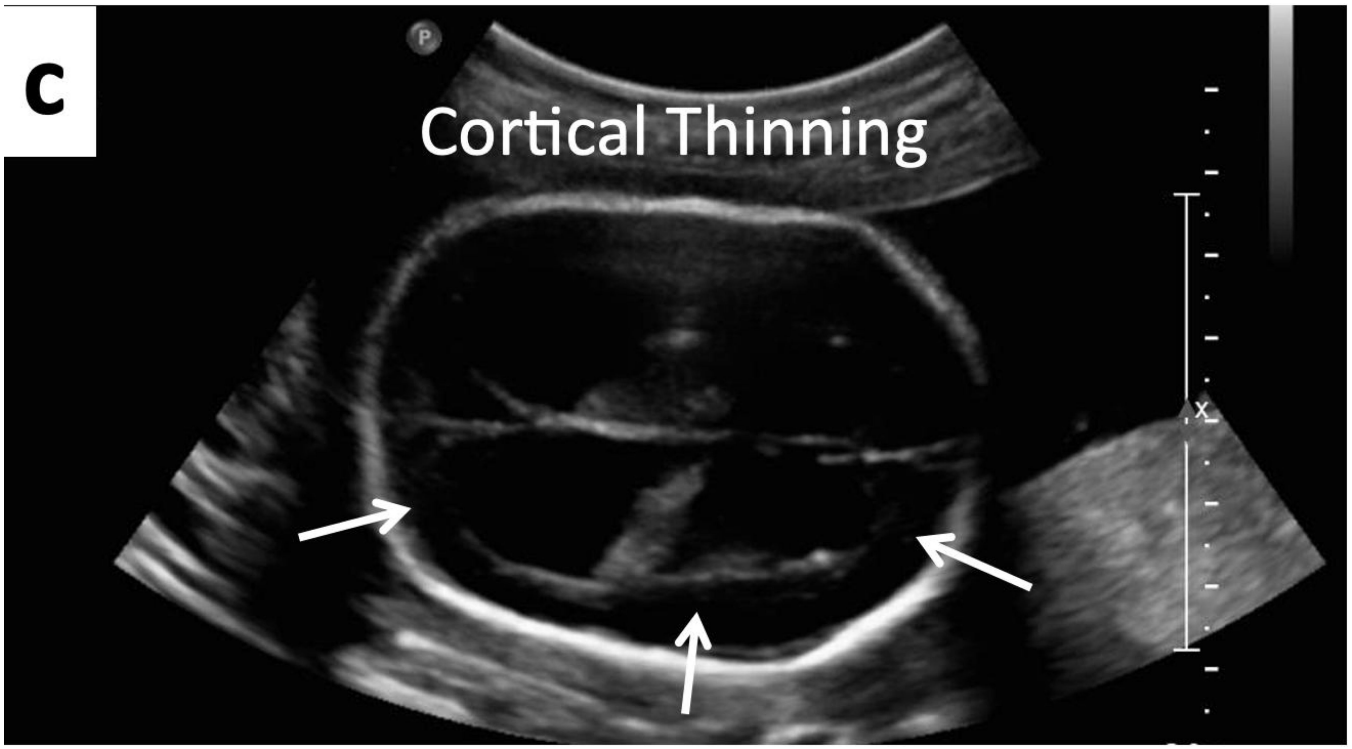
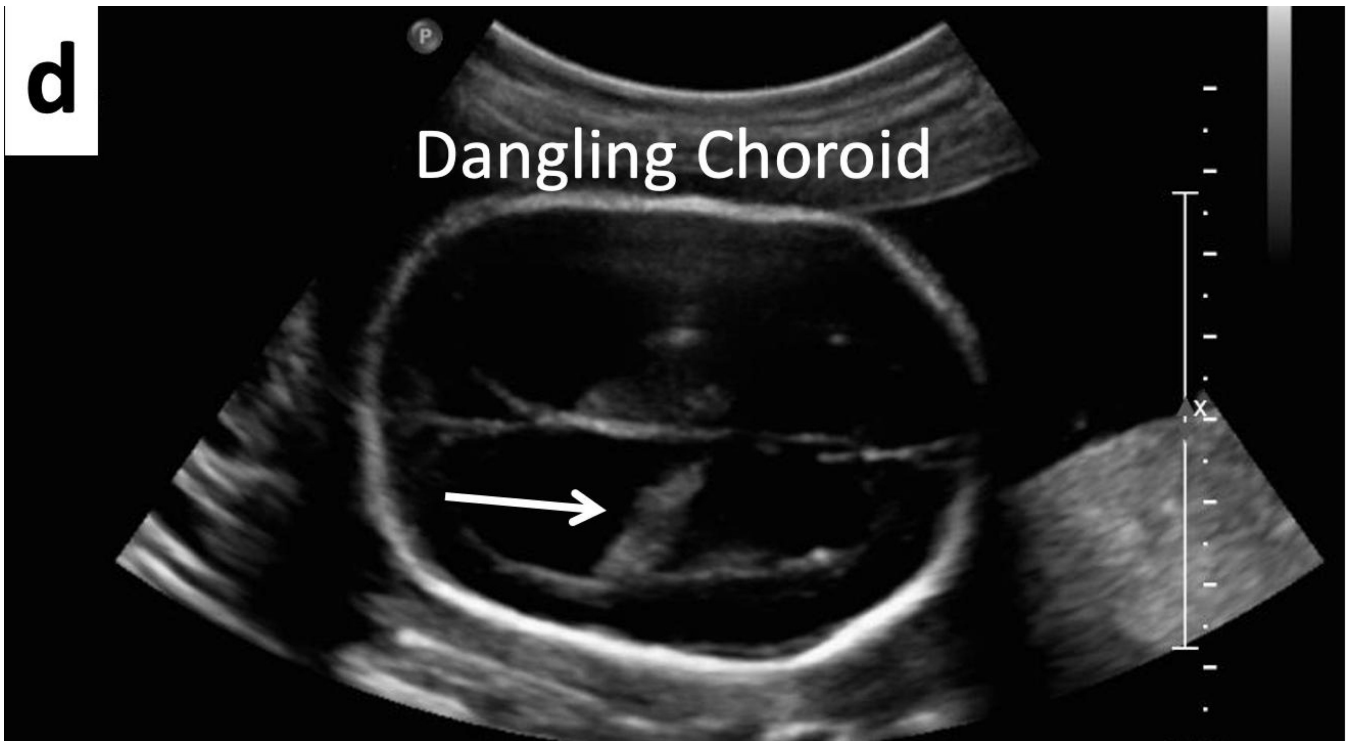








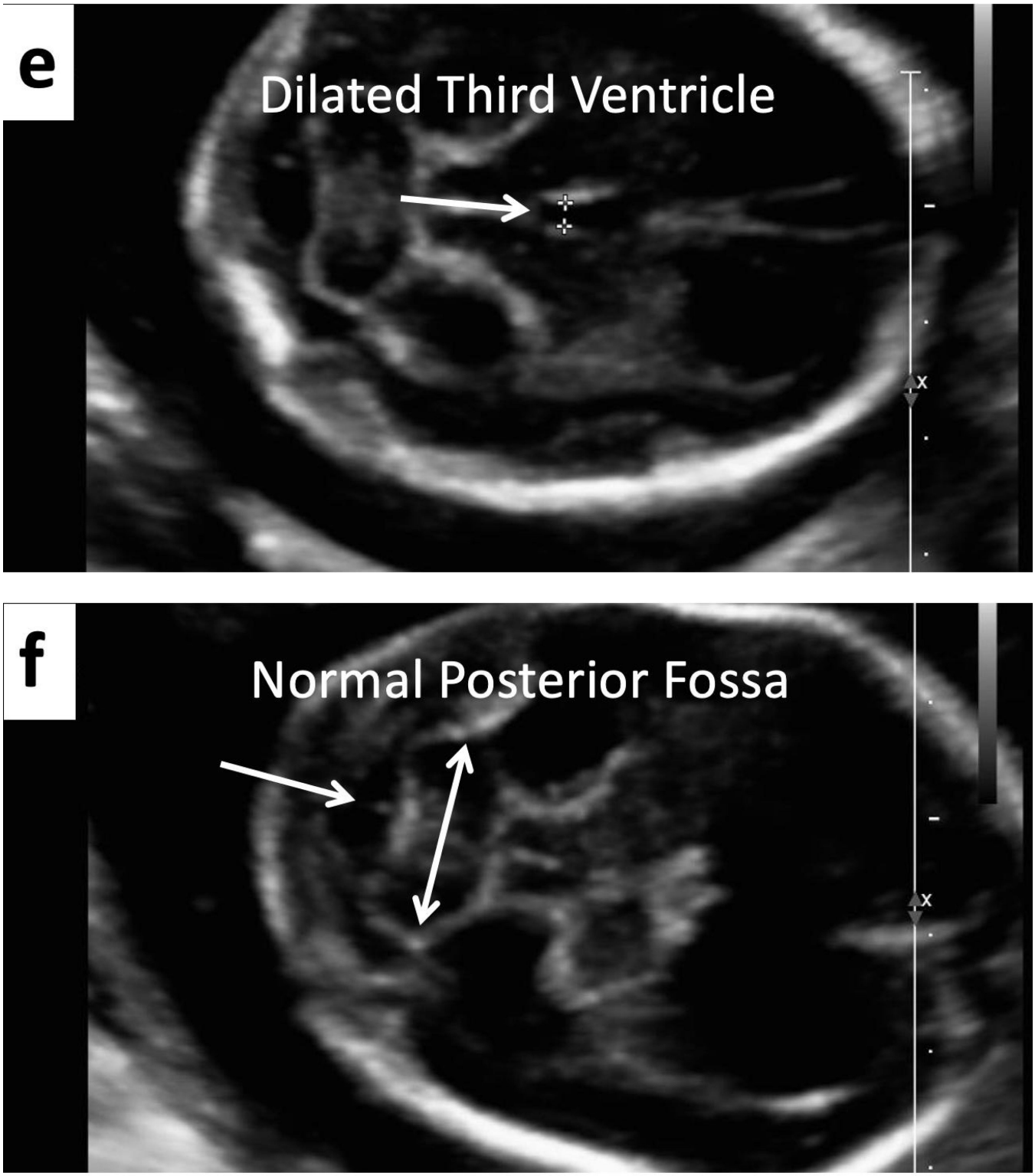


Fig. 1a-f.
Ultrasound findings in fetal AS

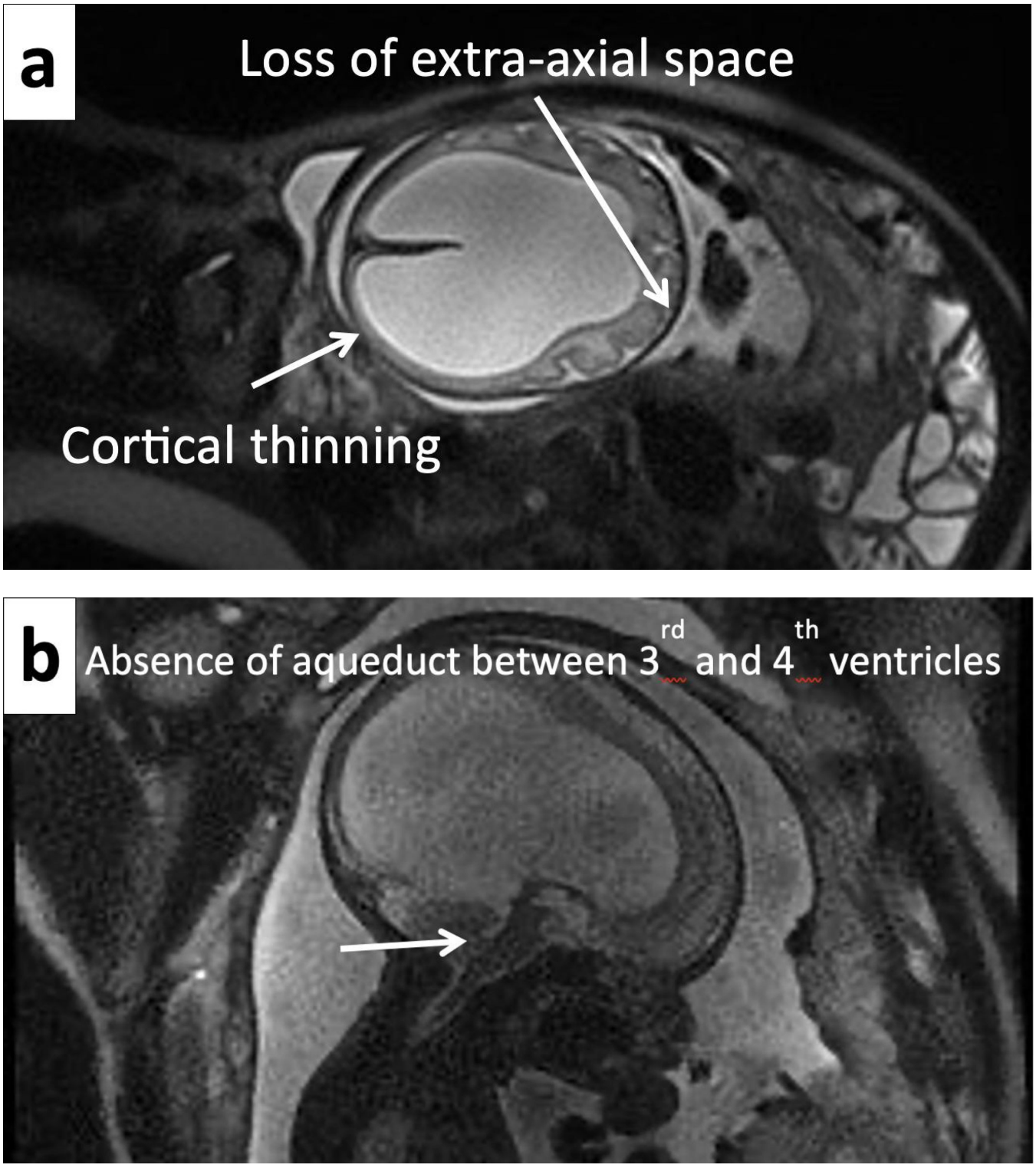


Fig. 2a, b.
MRI findings in fetal AS

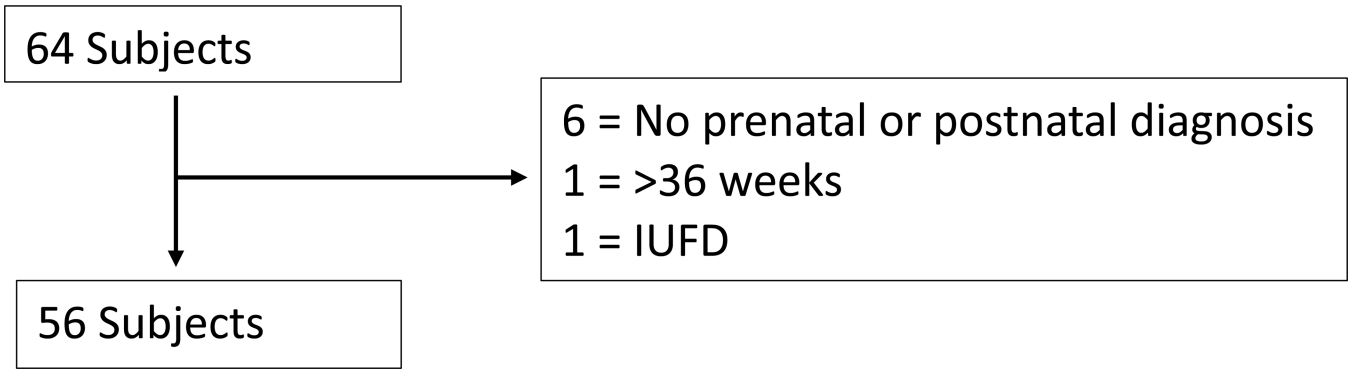
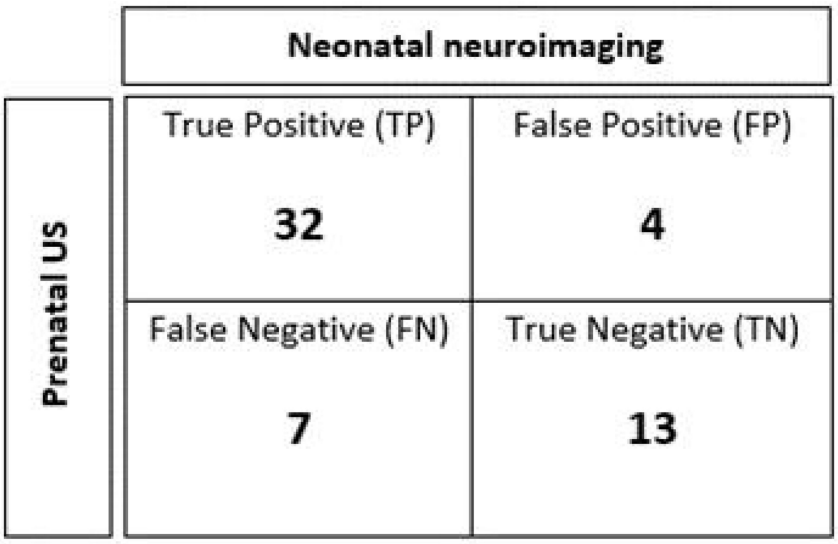


Fig. 3.
Flow Diagram



	Estimate	95% Confidence Interval	
		Lower limit	Upper limit
Sensitivity	0.82	0.66	0.92
Specificity	0.76	0.5	0.93
Positive predictive value	0.89	0.74	0.97
Negative predictive value	0.65	0.44	0.86

Fig. 4.
Ultrasound performance characteristics

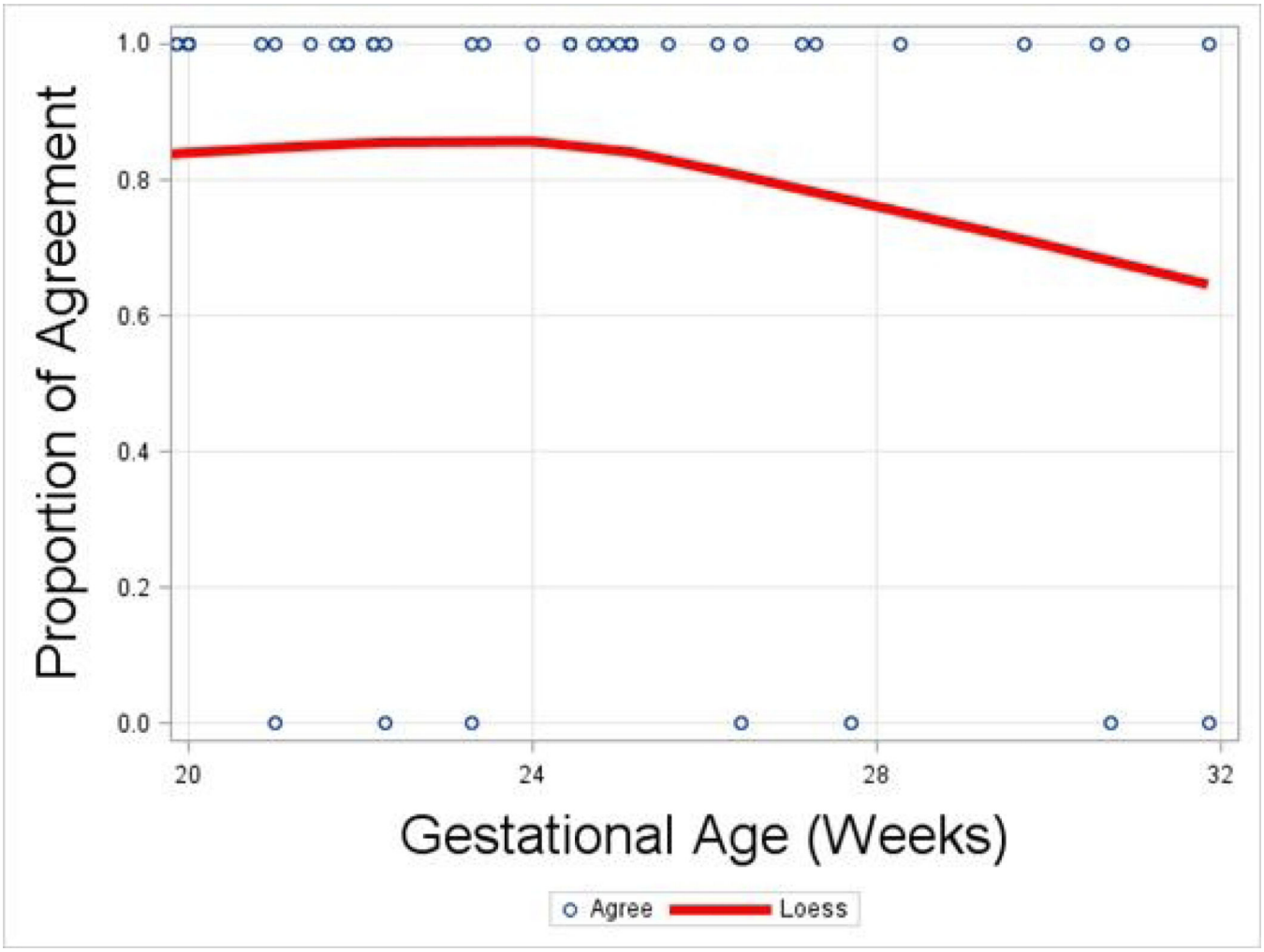
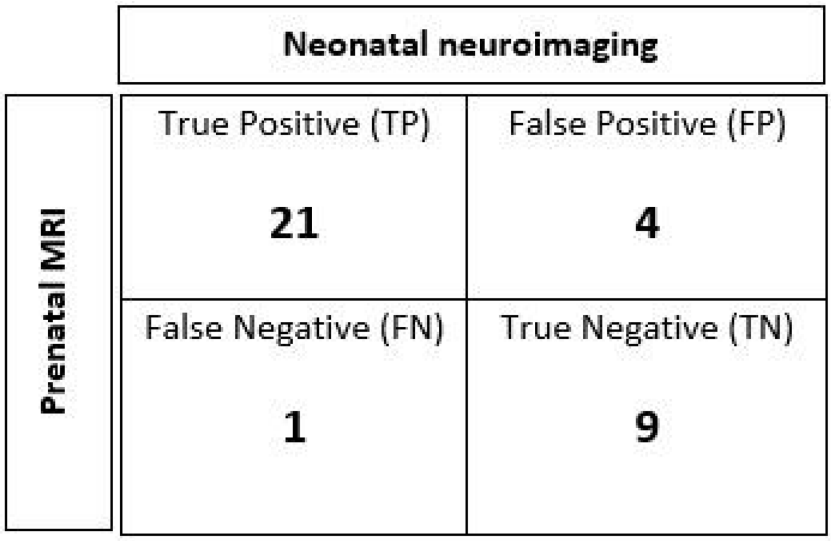


Fig. 5.
Ultrasound proportion of agreement by gestational age



	Estimate	95% Confidence Interval	
		Lower limit	Upper limit
Sensitivity	0.95	0.77	1.00
Specificity	0.69	0.39	0.91
Positive predictive value	0.84	0.64	0.95
Negative predictive value	0.90	0.56	1.00

Fig. 6.
MRI performance characteristics

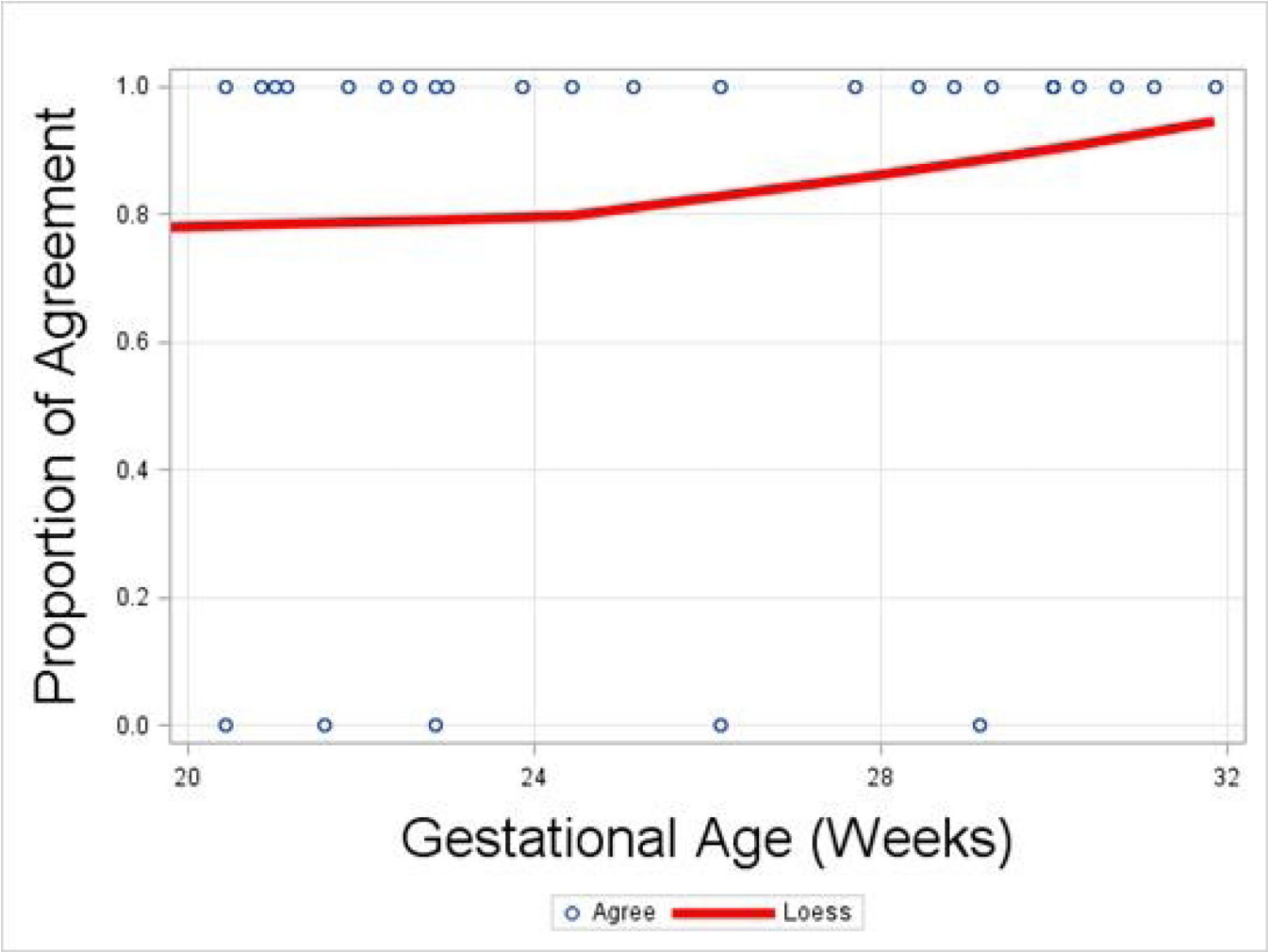


Fig. 7.
MRI proportion of agreement by gestational age

Table 1.

Demographics

Center	Pittsburgh	Milwaukee	Hopkins	U Michigan	CHOP	Denver	UT Houston	St Louis	UC Davis	Minneapolis	Stanford
Subjects	11	8	7	7	5	5	4	3	3	2	1
Age	Mean	Median	Range								
	29.3	29	19–41								
Gravida	Mean	Median	Range								
	2.6	2	1–7								
Para	Mean	Median	Range								
	1	1	0–5								
Race	Caucasian	Asian	Black	HPI	Unk						
	46	4	3	1	2						
Year	Mean	Median	Mode								
	2019	2020	2021								

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Table 2.

GA US Dx= gestational age of the ultrasound diagnosis of fetal AS. **US Sc**= degree of confidence of the diagnosis. **US Dx**=AS or not AS. **Post Dx**= postnatal diagnosis (gold standard). **US Score**=true positive, true negative, etc. **fMRI GA**= gestational age of the fetal MRI. **fMRI Dx**= fetal MRI diagnosis. **MRI score**=true positive, true negative, etc.

Subject	GA US Dx	US Sc	US Dx	Post Dx	Match	US Score		fMRI GA	fMRI Dx	Match	MRI Score
1	20w 0d	2	AS	AS	Yes	TP					
2	30w 5d	6	Not AS	AS	No	FN					
3	22w 1d	1	AS	AS	Yes	TP		22w 1d	AS	Yes	TP
4	26w 3d	1	AS	Not SA	No	FP		26w 1d	AS	No	FP
5	23w 2d	2	AS	AS	Yes	TP		19w 2d	AS	Yes	TP
6	24w 3d	6	Not AS	Not AS	Yes	TN		24w 3d	Not AS	Yes	TN
7	25w od	1	AS	AS	Yes	TP					
8	20w 0d	2	AS	AS	Yes	TP					
9	34w 5d	4	Not AS	Not AS	Yes	TN					
10	24w 6d	2	AS	AS	Yes	TP					
11	33w 2d	4	Not AS	Not AS	Yes	TN					
12	26w 1d	2	AS	AS	Yes	TP		30w 2d	AS	Yes	TP
13	29w 5d	3	Not AS	AS	No	FN		31w 1d	AS	Yes	TP
14	30w 4d	1	AS	AS	Yes	TP					
15	19w 1d	1	AS	AS	Yes	TP					
16	26w 1d	1	AS	AS	Yes	TP					
17	22w 2d	1	AS	AS	Yes	TP		22w 2d	AS	Yes	TP
18	33w 6d	4	Not AS	AS	No	FN		30w 0d	AS	Yes	TP
19	24w 5d	1	AS	AS	Yes	TP					
20	21w 0d	4	Not AS	AS	No	FN					
21	25w 4d	2	AS	AS	Yes	TP					
22	30w 6d	4	Not AS	Not AS	Yes	TN		30w 5d	Not AS	Yes	TN
23	19w 6d	2	AS	AS	Yes	TP					
24	21w 0d	6	Not AS	Not AS	Yes	TN					
25	23w 2d	5	Not AS	AS	No	FN					

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Subject	GA US Dx	US Sc	US Dx	Post Dx	Match	US Score		fMRI GA	fMRI Dx	Match	MRI Score
26	25w 1d	2	AS	AS	Yes	TP					
27	20w 0d	6	Not AS	Not AS	Yes	TN		31w 6d	Not AS	Yes	TN
28	20w 6d	1	AS	AS	Yes	TP		20w 6d	AS	Yes	TP
29	22w 6d	1	AS	AS	Yes	TP		22w 6d	AS	Yes	TP
30	25w 1d	2	AS	AS	Yes	TP		25w 1d	AS	Yes	TP
31	21w 3d	1	AS	AS	Yes	TP		20w 3d	AS	Yes	TP
32	32w 3d	2	AS	AS	Yes	TP		28w 3d	AS	Yes	TP
33	28w 6d	3	Not AS	AS	No	FN		28w 6d	AS	Yes	TP
34	31w 6d	2	AS	Not AS	No	FP		21w 4d	AS	No	FP
35	24w 3d	3	Not AS	Not AS	Yes	TN		20w 3d	AS	No	FP
36	25w 1d	1	AS	AS	Yes	TP		21w 1d	AS	Yes	TP
37	27w 2d	2	AS	AS	Yes	TP		32w 2d	AS	Yes	TP
38	24w 0d	4	Not AS	Not AS	Yes	TN					
39	28w 2d	2	AS	AS	Yes	TP					
40	35w 3d	3	Not AS	Not AS	Yes	TN		32w 2d	Not AS	Yes	TN
41	27w 1d	2	AS	AS	Yes	TP		30w 0d	AS	Yes	TP
42	21w 6d	1	AS	AS	Yes	TP		21w 6d	AS	Yes	TP
43	17w 2d	1	AS	AS	Yes	TP		21w 0d	AS	Yes	TP
44	23w 3d	2	AS	AS	Yes	TP					
45	28w 5d	1	AS	AS	Yes	TP		27w 5d	AS	Yes	TP
46	29w 5d	2	AS	AS	Yes	TP		29w 2d	AS	Yes	TP
47	31w 6d	6	Not AS	Not AS	Yes	TN		34w 1d	Not AS	Yes	TN
48	36w 3d	3	Not AS	Not AS	Yes	TN		37w 4d	Not AS	Yes	TN
49	19w 6d	6	Not AS	Not AS	Yes	TN		23w 0d	Not AS	Yes	TN
50	18w 1d	2	AS	Not AS	No	FP		22w 4d	Not AS	Yes	TN
51	21w 5d	6	Not AS	Not AS	Yes	TN			Not AS	Yes	TN
52	22w 2w	6	Not AS	AS	No	FN		22w 6d	Not AS	No	FN
53	22w 1d	1	AS	AS	Yes	TP		26w 1d	AS	Yes	TP
54	27w 5d	1	AS	Not AS	No	FP		29w 1d	AS	No	FP

Subject	GA US Dx	US Sc	US Dx	Post Dx	Match	US Score		fMRI GA	fMRI Dx	Match	MRI Score
55	32w 1d	2	AS	AS	Yes	TP					
56	21w 6d	2	AS	AS	Yes	TP		23w 6d	AS	Yes	TP