

Tomographic ultrasound imaging of the developing fetal cortex: Diagnostic agreement with fetal MRI

Dr. Rehab Raafat MD .Ph.D. Consultant Women’s and fetal imaging

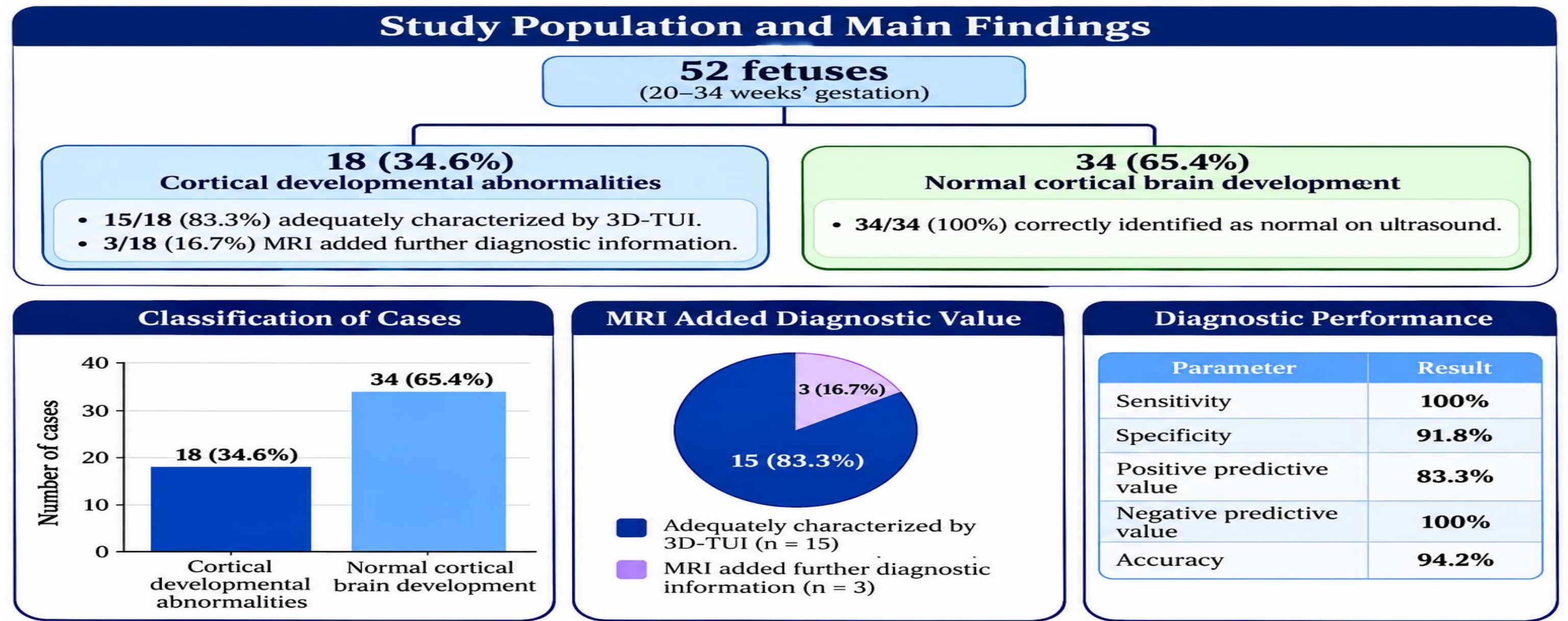
Introduction

Understanding the process of cortical development is essential for understanding cortical malformations that can be detected at various stages of gestation, in turn Informing decisions about the timing of imaging, genetic testing and clinical decision making.1A greater number of congenital brain malformations can be identified prenatally. Among them , Malformations of cortical development , a family of congenital brain anomalies specifically Affecting the cerebral cortex and often the cerebrum more broadly 2,3 . Although the exact incidence is not known, they are associated with significant long-term morbidity, Including neurodevelopmental impairment, intellectual disability, cerebral palsy and epilepsy.4,5

Patient and method

This retrospective study included **52 pregnancies** referred between **20 and 34 weeks of gestation** for suspected congenital abnormalities. All fetuses underwent detailed fetal anomaly scan and acquisition of **3D fetal brain volumes followed by Tomographic Ultrasound Imaging (3D-TUI)** reconstruction for multiplanar assessment of cortical development and sulcation. The ultrasound findings were compared with **fetal MRI** performed as part of the diagnostic evaluation. The final diagnosis was established using **postnatal neuroimaging (CT or MRI)** as the reference standard when available.

Results



Discussion

Prenatal diagnosis of fetal cortical brain lesions is challenging because cortical maturation continues throughout gestation. Three-dimensional Tomographic Ultrasound Imaging (3D-TUI) enables detailed assessment of cortical morphology and serves as an excellent first-line imaging modality. However, fetal MRI provides superior soft-tissue contrast and more accurate characterization of subtle cortical abnormalities, particularly when ultrasound findings are inconclusive. Postnatal MRI remains the reference standard for confirming the diagnosis and evaluating the accuracy of prenatal imaging. Our findings support the complementary use of expert neurosonography and fetal MRI to optimize prenatal diagnosis and counseling.

Conclusion

3D-TUI demonstrated high diagnostic performance in the assessment of fetal cortical development and accurately characterized most cortical abnormalities. Fetal MRI provided additional diagnostic information in a subset of cases, supporting its complementary role when ultrasound findings are complex or incompletely characterized

References

- 1 Subramanian L, Calcagnotto ME, Paredes MF. Cortical malformations: Lessons in human brain development. *Front Cell Neurosci.* 2019;13:576.
- 2 Severino M, Geraldo AF, Utz N, et al. Definitions and classification of malformations of cortical development: Practical guidelines. *Brain.* 2020;143:2874–2894.
- 3 Van den Veyver IB. Prenatally diagnosed developmental abnormalities of the central nervous system and genetic syndromes: A practical review. *Prenat Diagn.* 2019;39:666–678.
- 4 Guerrini R, Dobyns WB. Malformations of cortical development: Clinical features and genetic causes. *Lancet Neurol.* 2014;13:710–726.[Google Scholar](#)[Crossref](#)[PubMed](#)[WorldCat](#)
- 5 Simmons R, Martinez AB, Barkovich J, et al. Disorders of neuronal migration/organization convey the highest risk of neonatal onset epilepsy compared with other congenital brain malformations. *Pediatr Neurol.* 2022;127:20–27.
- 6 Glenn OA. MR imaging of the fetal brain. *Pediatric Radiology.* 2010;40:68–81.
- 7 Malinge G, Paladini D, Pili G, et al. ISUOG Practice Guidelines: Sonographic examination of the fetal central nervous system. *Ultrasound in Obstetrics & Gynecology.* 2021.
- 8 Prayer D, Malinge G, Brugger PC, et al. ISUOG Practice Guidelines: Performance of fetal magnetic resonance imaging. *Ultrasound in Obstetrics & Gynecology.* 2017

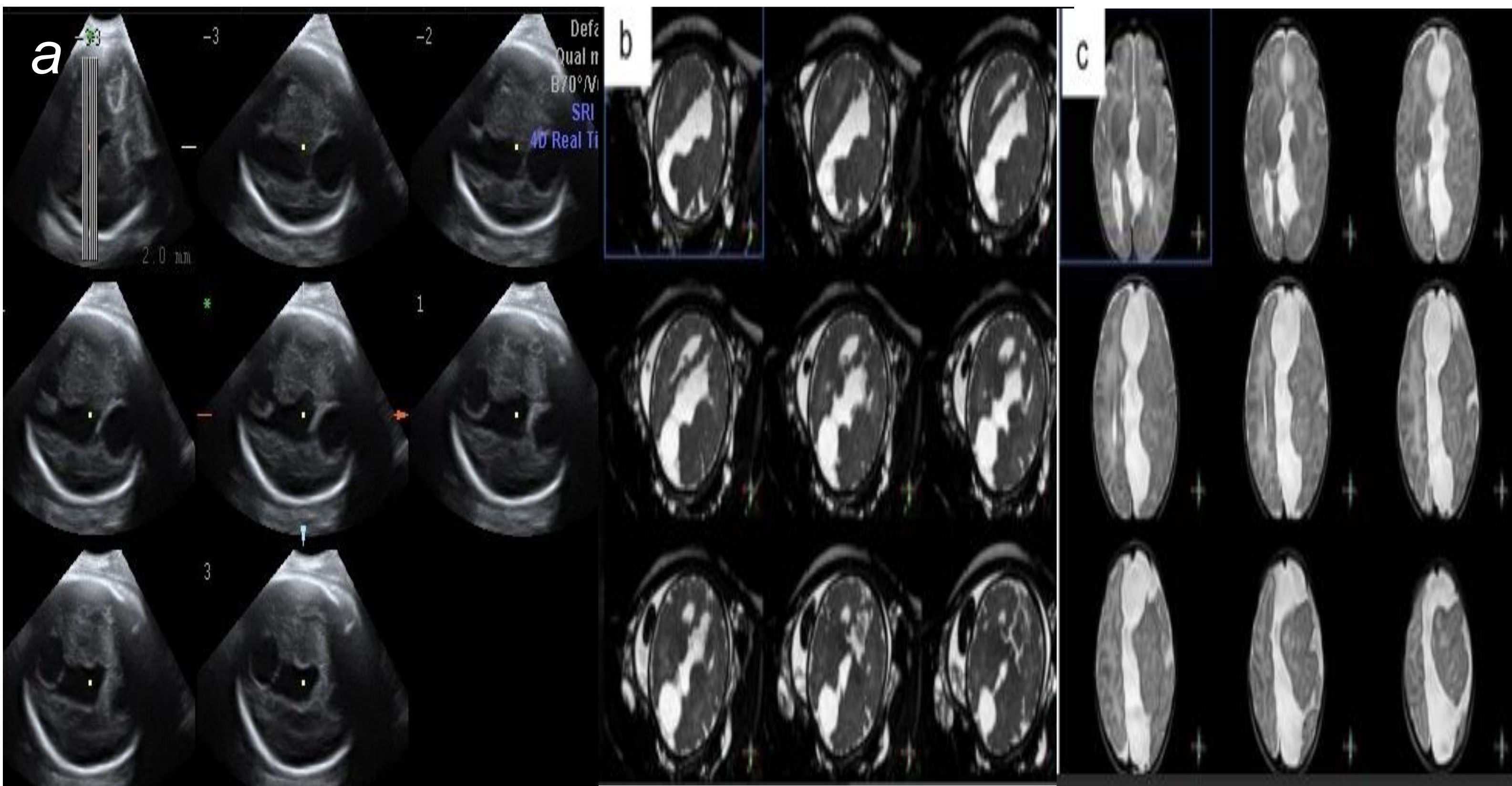


Figure 1.a TUI serial study shows cortical disruption , midline interhemispheric cyst and ACC

Figure 1.b. Fetal MRI (T2-weighted single-shot fast spin-echo) showing axial ,cortical disruption (schizencephaly), midline interhemispheric cyst and ACC

Figure 1.c post natal MRI T2WI confirmed the diagnosis

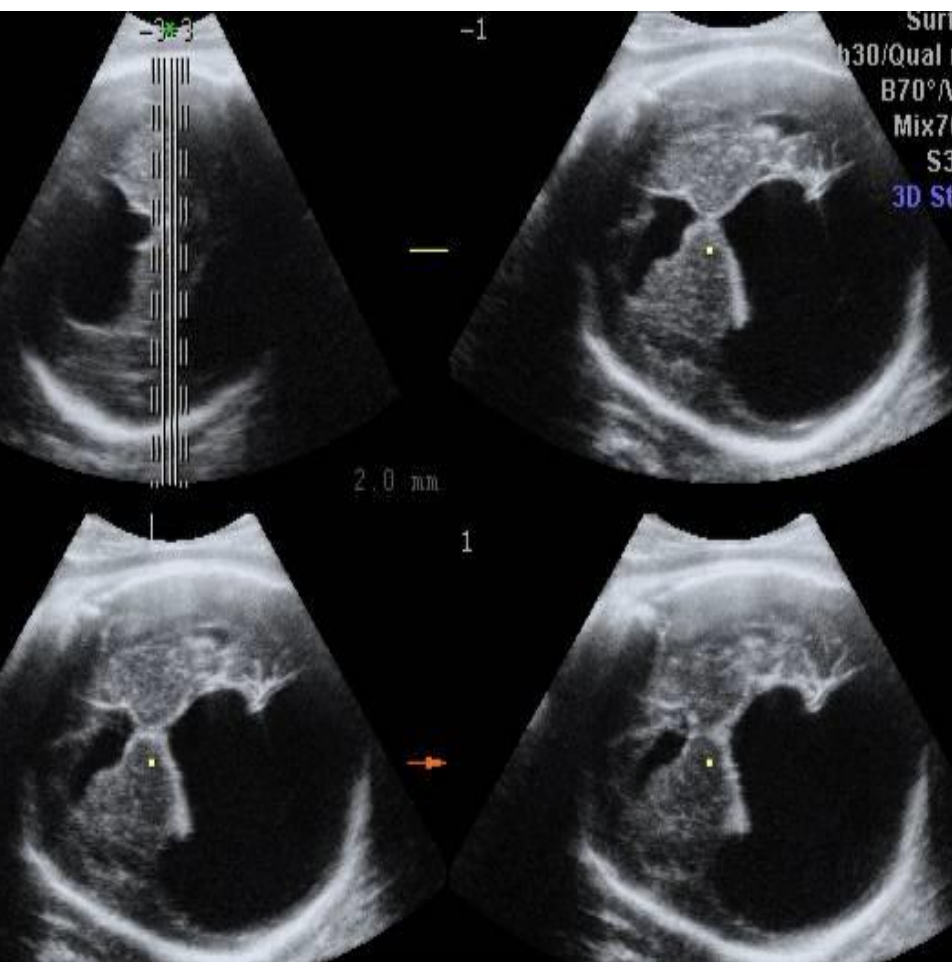


Figure 2.
3D TUI of the brain shows large size cyst in the right parieto-occipital junction communication with right lateral ventricle with cortical disruption .

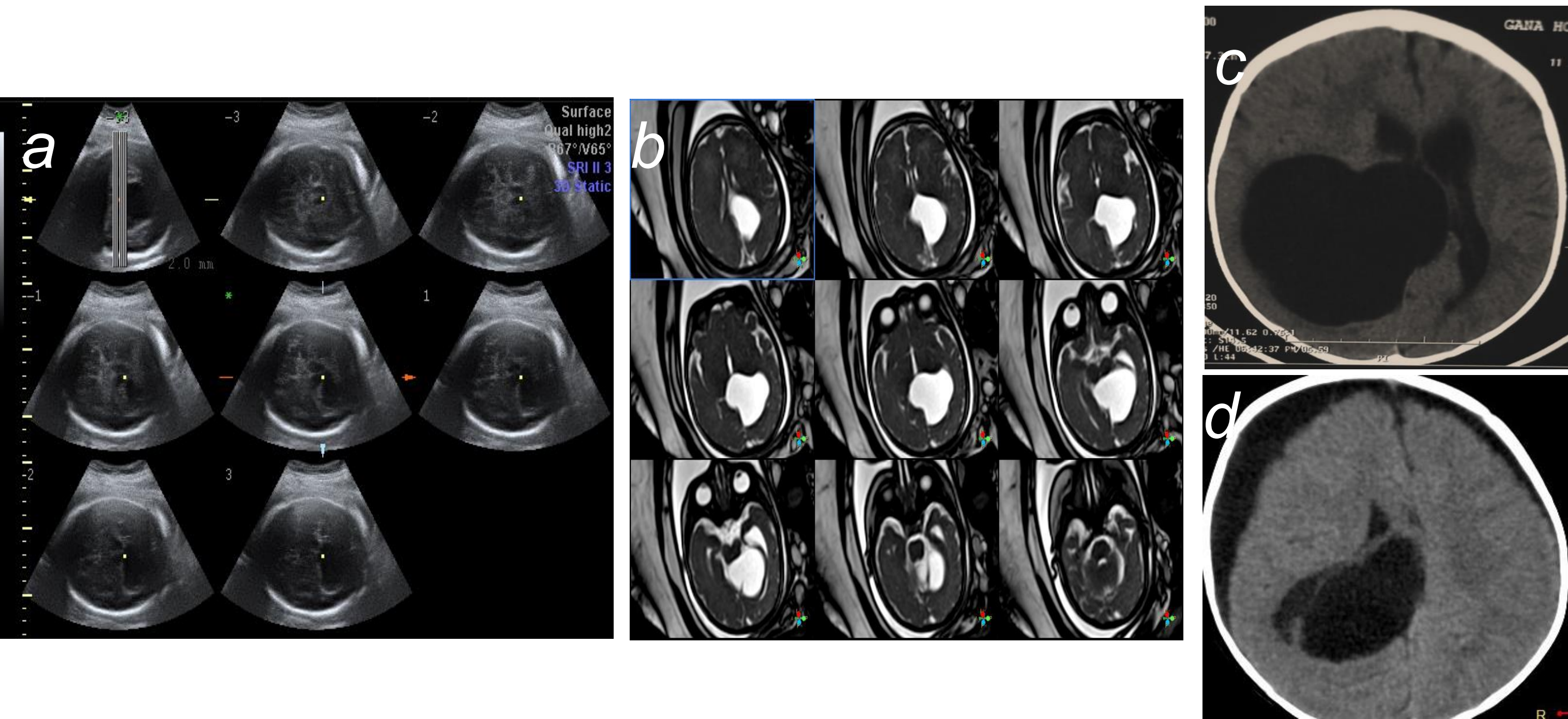


Figure 3.
a. 3D TUI shows para-midline cystic lesion .b. Fetal MRI (T2 SSFSE) shows the para-midline cystic lesion non communicating with and compressing the lateral ventricle suggesting the diagnosis of arachnoid cyst not porencephalic cyst .c. post natal immediate CT confirm the diagnosis .d. CT two month later.