

Fetal MRI versus US: A prospective study

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1 - Introduction

Evaluate the magnetic resonance (MRI) as method of diagnosis of malformations of the face, trunk and fetal members, with use of comparative score between this and the ultrasound scan (US), considered the non-invasive evaluation method of choice.

2 - Objectives

→ Compare MRI to US as diagnosis method in fetuses with non-cns malformations

→ Compare the fetal evaluation of no-pathological organs on MRI and US.

→ Verify the influence of existent pathology in the accuracy of MRI and US

3 - Material and methods

They were studied 66 fetuses between 17 and 37 from the Obstetrics and Gynecologists section of University of Medicine of the São Paulo University - FMUSP. The inclusion in the study happened after the formal consent. Exclusion criteria: first trimester, high-risk pregnancy and formal MRI contraindications.

3.1 - Imaging

MRI images were obtained with an 1,5 Tesla scanner in the Heart Institute (INCOR) of the Medicine Faculty of the São Paulo University (FMUSP). The US were executed in a Philips; model HDI-5000@.

3.2 - Methods

For comparison effect with MRI, all of the fetuses were examined using US in three anatomical incidences: Sagittal, coronal and axial, of the whole body. The MRI technique: T2 weighted Single Shot Fast Spin-Echo, Field-of-view between 18 and 32 cm (only variable parameter, depending on the size of the uterus); TR among 60 and 90 ms, TE between 15000 and 60000 ms; 5 mm slice thickness; 512 for 512 points matrix and number of acquisitions (NEX) of one.

3.3 - US and MRI evaluation

A double-blind MRI read was performed by the radiologists and the consensus used among them for the detection of pathologies. One of the readers applied the scores described below.

First score: Possibility of accomplishment of the sequences in axial, coronal and sagittal in the two methods, being given scores 0 (zero) for plans not studied and 1 (one) if such plans were studied in the head, thorax, abdomen and fetal pelvis, in a total of 1584 scores.

Second score: Technical quality of the accomplished exam, without analysis of associated pathologies, with scores from 0 to 3, (0 - not studied, 1 - only located by anatomic relation, 2 - located and studied, although without great details, 3 - located and anatomy well studied).

Third score: Capacity in identify pathology, scores from 0 to 2 (0 - not studied, 1-without pathology and 2-with pathology) the same organs studied previously. 45 scores given for each method in each case, in a total of 5400 scores for the second and third scores.

Anatomical repairs for second and third scores: Skull: Lateral ventricles choroid plexus, corpus callosum, eyes, white/gray matter differentiation, gyri and posterior fossa; in the face: Mouth, ears, nose and eyes; in the thorax: Trachea, lungs, heart and thymus; in the abdomen/Pelvis: liver, spleen, bowels, kidney, genitals and gonads in the limbs: Feet and hands.

4 - Results

First score: Proposed plans studies were performed in 100% of the cases by MRI and in the US it was not possible in the skull: coronal 6,1% (4 cases), sagittal 3,0% (2 cases); thorax: coronal 7,6% (5 cases); abdomen: coronal 3,0% (2 cases); pelvis: coronal 1,5% (1 case) and sagittal 1,5% (1 case).

Second score: The Kappa (K) agreement index, good reproducibility was observed independently between MRI and US without correlation with local pathology: mouth (K = 0.80; p < 0.001), eyes (K = 0.815; p < 0.001) and nose (K = 0.77; p < 0.001) in the face; and intestines (K = 0.67; p < 0.001) in the abdomen.

Third score: Using Kappa index result is observed when being considered the co-existence pathology in the following places: Lateral ventricles (K = 0.68; p < 0.001) and choroid plexus (K = 0.48; p = 0.002) in the central nervous system (CNS); lungs (K = 0.61; p < 0.001) and heart (K = 0.80; p < 0.001) in the thorax; liver (K = 0.65; p < 0.001), intestine (K = 0.65; p < 0.001) and kidneys (K = 0.78; p < 0.001) in the abdomen.

MRI obtained superior evaluation (decreasing order of scores): posterior fossa, eyes, lateral ventricles, gyri, kidneys, white and gray matter differentiation, liver, nose, mouth, hands and ears.

US was better in: Heart, choroid plexus, intestines and corpus callosum analysis.

No association among the scores given to MRI and the gestational age.

Main diagnostic discrepancies:

Rib agenesis for US and as Arnold-Chiari type II (confirmed after birth) by MRI.

Thoracic kidney was not noticed US and two cases of renal agenesis suspicion, both confirmed by MRI.

Two cases of pachygyria were not diagnosed by US.

The ventriculomegaly (lateral ventricles, 3rd and 4th) were better accomplished in several studied cases.

Cerebellum had diagnosed of partial agenesis, cyst and tonsils herniation better appraised by MRI.

5 - Discussion

The normal sites that had data added by MRI, happened in its majority, in the same anatomical places in that this method was demonstrated superior to US, corroborating the result of the score to these places. The largest increment felt in cases that affected CNS and the urinary tract (independent of the amniotic fluid volume). Cases of lung pathologies, liver and of abdominal wall also had earnings diagnosis, mainly if such pathologies had rich content in water (i.e., cysts). The lungs sign alteration also enriched the diagnosis in MRI, not being possible by US. MRI had diagnostic ability loss in relation to US when evaluating heart and great vases mainly and less frequently extremities of the members, musculature and genitals (mainly feminine). Cases that associate calcifications were also better evaluated by US, being limit for MRI in adults' exams. Blood, masses or fat collections need T1 sequence increment. When accomplished in this study, the sequence T1 enriched the final results.

Some critics to this research should be noticed. The comparative score was used with base in other work that used scale of scores with smaller number of scores, although its usefulness has been proven in the US scans qualification 12. Analysis was not accomplished intra and inter-observer in the present study, what could increase the accuracy (lack of available professionals). Only seven of the accomplished cases did not have post-deliver evaluation, for the patients' escape. Another point to be noticed was the non-evaluation of the impact of MRI in the patient's handling.

6 - Conclusion

MRI increased data in relation to US in the posterior fossa evaluation, eyes, lateral ventricles, gyri, kidneys, white and gray substance differentiation, liver, nose, mouth, hands and ears.

There was good correlation between MRI and US in the evaluation of the normal fetal anatomy.

The concomitance of pathologies reduced the diagnostic accuracy more especially in US than in MRI.

The gestational age was influential factor in US, but not in MRI in the evaluation of the fetal anatomy.