Placental MR imaging in Fetuses with Placental Insufficiency

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TARGET AUDIENCE: Radiologists with subspecialties in Obstetrics & Gynecology

PURPOSE: Fetal MR imaging is increasingly used as a complementary tool to obstetric ultrasonography (US) in selected cases to verify equivocal findings as seen at US. Despite the fact that MR imaging helps delineate the morphologic alterations of the placenta, few studies have addressed the functional properties of the placental vasculature.[1] We hypothesized that evaluating flow voids (FVs) on T2-weighted rapid acquisition with relaxation enhancement (RARE) images can be used as an additional information to identify placental insufficiency in fetuses whose placental supply is substantially altered, leading to fetal growth restriction (FGR). Thus, the purpose of this study was to evaluate morphologic and signal intensity changes of placental insufficiency on MR imaging and to assess value of morphologic changes and decreased FVs on T2-weight RARE MR imaging for diagnosing placental insufficiency.

MATERIALS AND METHODS: Fifty singleton fetuses (50 pregnant women) with abnormal findings at obstetric US underwent MR imaging that included T2-weight half-Fourier RARE (TR/TEeff, 1500/60) and T1-weighted fast low-angle shot (TR/TE, 150/4.76, flip angle = 90°) using a 1.5 T whole body scanner with a phased array. Placental insufficiency was diagnosed if fetal weight estimated with obstetric US was below the 5th percentile. Findings from histopathologic examination of the placenta were available in all fetuses. Placental thickness was taken as the thickness of the placental parenchyma at the point of central umbilical cord insertion. Placental areas were calculated as follows: placental area = *pi* × maximal placental longitudinal length/2 × maximal placental transverse length/2. Placental volumes were calculated as follows: volume = placental thickness × placental area × 2/3. Placental signal intensity was assessed in relation to the amniotic fluid signal intensity by measuring the signal intensity in the largest possible region of interest on the slice that contained the maximal area of both placenta and amniotic fluid with no image artifact present. Two radiologists reviewed T2-weight RARE images for globular appearances of the placentas and FVs between the uterus and the placenta. A thickened appearance or no tapering edges of the placenta was diagnosed as positive signs of a globular appearance of the placenta. None or decreased size and number of FVs between the uterus and the placenta was diagnosed as positive signs of decreased FVs. The *t* tests and McNemar's tests were used to compare these results at 5% levels of significance.

RESULTS: Twenty-five of the 50 pregnancies were categorized as having an insufficient placenta. Table 1 shows the mean placental areas, placental thicknesses, and placental volumes in fetuses with placental insufficiency and fetuses without placental insufficiency. There was a significant decrease in the placental area in in fetuses with placental insufficiency ($p < 0.01$). There was a significant increase in the placental thickness in fetuses with placental insufficiency ($p < 0.01$). There was a significant decrease in the placenta to amniotic fluid signal intensity ratio (SIR) in in fetuses with placental insufficiency ($p < 0.01$).Table 2 shows sensitivity, specificity, and accuracy with globular appearances, decreased FVs, and globular appearances plus decreased FVs. The use of decreased FVs in addition to globular appearances increased sensitivity for the detection of placental insufficiency from 76.0% to 88.0%, increased accuracy from 78.0% to 82.0%, and preserved specificity at 76.0%. There is a significant difference in sensitivity between decreased FVs and globular appearances plus decreased FVs.

DISCUSSION: Our finding of a reduction in placental area in FGR is supported by a histopathological study.[2] Focal loss of endovascular trophoblast may be the cause of the smaller dysfunctional placenta in FGR. There was a significant increase in the placental thickness in FGR in our study. This may be a reflection of reduction in placental surface area and a compensatory mechanism for placental insufficiency. A reduction in the placenta to amniotic fluid signal intensity ratio was thought to be a reflection of a loss of placental tissue density. Globular appearances of placentas were reflected in changes a reduction in placental area and an increase in placental thickness in FGR.[3] Decreased FVs between the uterus and the placenta were thought to be a reflection of reduced utero-placental flow leading to the development of a hypoperfused placenta.[1] In our series, globular appearances at MR imaging were detectable in 19 fetuses with FGR. Globular appearances plus decreased FVs was found in 22 fetuses with FGR. The decreased FVs on T2-weighted RARE images can be useful for detecting placental insufficiency.

CONCLUSION: Placental insufficiency associated with FGR is associated with placental areas, placental thicknesses, and placenta to amniotic fluid signal intensity ratios. Evaluating FVs on T2-weighted RARE images can be useful for detecting placental insufficiency, particularly in placentas without globular appearances on MR imaging.

Table 1 mean placental thicknesses, placental areas, placental volumes, and placenta to amniotic fluid signal intensity ratio in fetuses with and fetuses without placental insufficiency

	Fetuses with placental insufficiency	Fetuses without placental insufficiency	P value
Placental area (mean ± S.D.)	16159.8 ± 6959.3 mm^2	26724.8 ± 9442.8 mm^2	< 0.01
Placental thickness (mean ± S.D.)	53.4 ± 15.3 mm	37.1 ± 7.0 mm	< 0.01
Placental volume (mean ± S.D.)	555321.5 ±200482.8 mm^3	657169.2 ± 268990.1 mm^3	> 0.05
Placental to amniotic fluid SIR (mean ± S.D.)	0.545 ± 0.153	0.685 ± 0.190	< 0.01

Table 2 Sensitivity, specificity, accuracy with globular appearances, decreased FVs, and globular appearances plus decreased FVs

	globular appearances	decreased FVs	globular appearances plus decreased FVs	P value
Sensitivity	19/25 (76.0%)	13/25 (52.0%)[a]	22/25 (88.0%)[a]	< 0.05[a]
Specificity	20/25 (80.0%)	22/25 (88.0%)	19/25 (76.0%)	> 0.05
Accuracy	39/50 (78.0%)	35/50 (70.0%)	41/50 (82.0%)	> 0.05

Note – [a] There is a significant difference between decreased FVs and globular appearances plus decreased FVs.

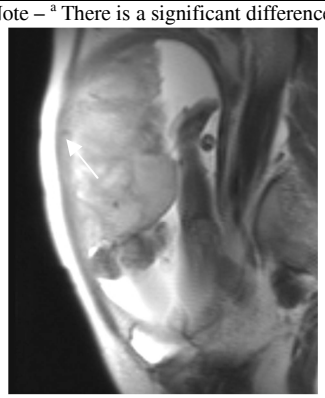

Figure 1 FGR with globular appearance and in decreased FVs a 29-year-old pregnant woman at 33 weeks gestation. T2-weighted RARE image shows the thickened placenta with no tapering edges and decreased size and number of flow voids between the uterus and the placenta (arrow)

Figure 2 Normal placenta. Fetus had a normal size for 36 weeks gestation and a normal weight at birth. T2-weighted RARE image shows the normal size of placenta with tapering edges and normal size of clear FVs between the uterus and the placenta (arrows)

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