



Magnetic resonance imaging T1 relaxation properties of fetal blood in normal fetuses and fetuses suspected of anemia

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Objective

MRI T1 relaxation time is inversely proportional to haemoglobin (Hb) level in the blood. Our aim was to investigate the ability of T1 relaxation time to predict fetal anemia.

Methods

Normal fetuses and fetuses suspected of anemia (PSV in MCA > 1.5 MoM) due to Rh alloimmunisation or twin anemia-polycythemia sequence were scanned in a 1.5T Siemens MRI scanner 1-5 times during pregnancy. Fetuses suspected of anemia were scanned before as well as after their planned intrauterine blood transfusions. We used a T1-mapping MOLLI sequence of 8 seconds for a cross section scan of the umbilical vein (UV) (Fig. 1). We compared T1 relaxation time values between normal fetuses and fetuses suspected of anemia using the method of generalized estimating equation to account for the correlation within fetuses.

Results

In 15 normal fetuses (39 scans) T1 values were 1005-1391 ms. In 6 fetuses suspected of anemia 8 scans were performed before blood transfusion (two fetuses had two blood transfusions). In 6 of these scans T1 values were 1437-1591 ms and anemia showed to be moderate or severe (Hb 1.5-5.9 mmol/L). T1 values in the remaining two scans were 1199 and 1410 ms and anemia showed to be mild (Hb 8.6 and 7.8 mmol/L, respectively). After blood transfusions (35-110 ml) Hb levels were 8.7-9.7 mmol/L in all eight cases and T1 values dropped to 1095-1280 ms. The mean of T1 values before blood transfusion in fetuses with moderate and severe anemia were 245 ms higher than the mean of T1 values in normal fetuses (95%CI 176-313 ms, $P < 0.001$). The mean of T1 values after blood transfusion were 27 ms lower than the mean of T1 values in normal fetuses (95%CI -98-42 ms, $p = 0.439$). T1 values from all scans are presented in Fig. 1. A T1 value cut-off of 1425 ms would identify all fetuses with moderate and severe anemia in this study, with no false-positives.

Conclusion

T1 values in the fetal UV may be a new interesting non-invasive tool for prediction of moderate and severe anemia.

Fig. 1: Anatomical (a,b) and T1 mapping (c) pictures by MRI of the fetal umbilical vein (red arrows) and T1 value results

