Synthetic MRI-based Fast Gray Matter Acquisition T1 Inversion Recovery (FGATIR) Contrasts identify Neonatal Brainstem Pathways *in Vivo*

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OBJECTIVE:

SyMRI® allows to reconstruct different MRI contrasts using a single multi-dynamic multi-echo (MDME) sequence acquisition[1]. This study aimed to investigate the feasibility of synthetic MRI-based fast gray matter acquisition T1 inversion recovery (FGATIR) contrasts[2] for the qualitative identification of early myelinating neonatal brainstem pathways *in vivo*.

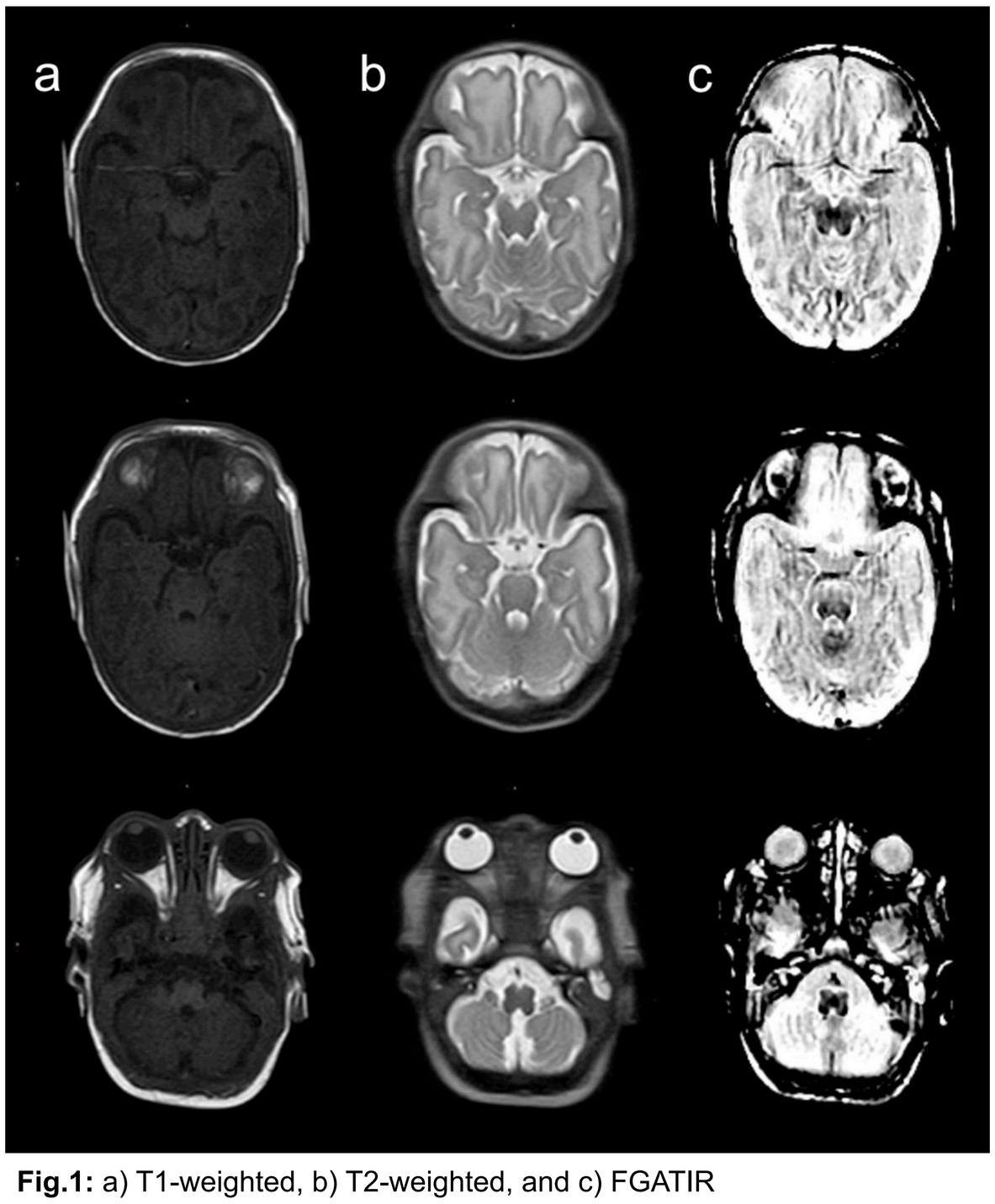

Fig.1: a) T1-weighted, b) T2-weighted, and c) FGATIR

METHODS AND MATERIALS:

Thirty-one cases of neonatal MRI (median gestational age at birth: 27+0; range, 23+4–41+6) were collected, which included MDME sequences and conventional T1-weighted/T2-weighted sequence acquisitions (standard-of-reference). MDME-based FGATIR contrasts (TR/TE/TI: 3000/5/410 ms) were generated using the MR data post-processing software SyMRI®. The identification of seven brainstem pathways was assessed on synthetic FGATIR contrasts and conventionally acquired T1-weighted/T2-weighted imaging data: decussation of superior cerebellar peduncle (DSCP); left/right medial lemniscus (ML); left/right central tegmental tract (CTT); and left/right longitudinal medial fascicle (LMF)[2].

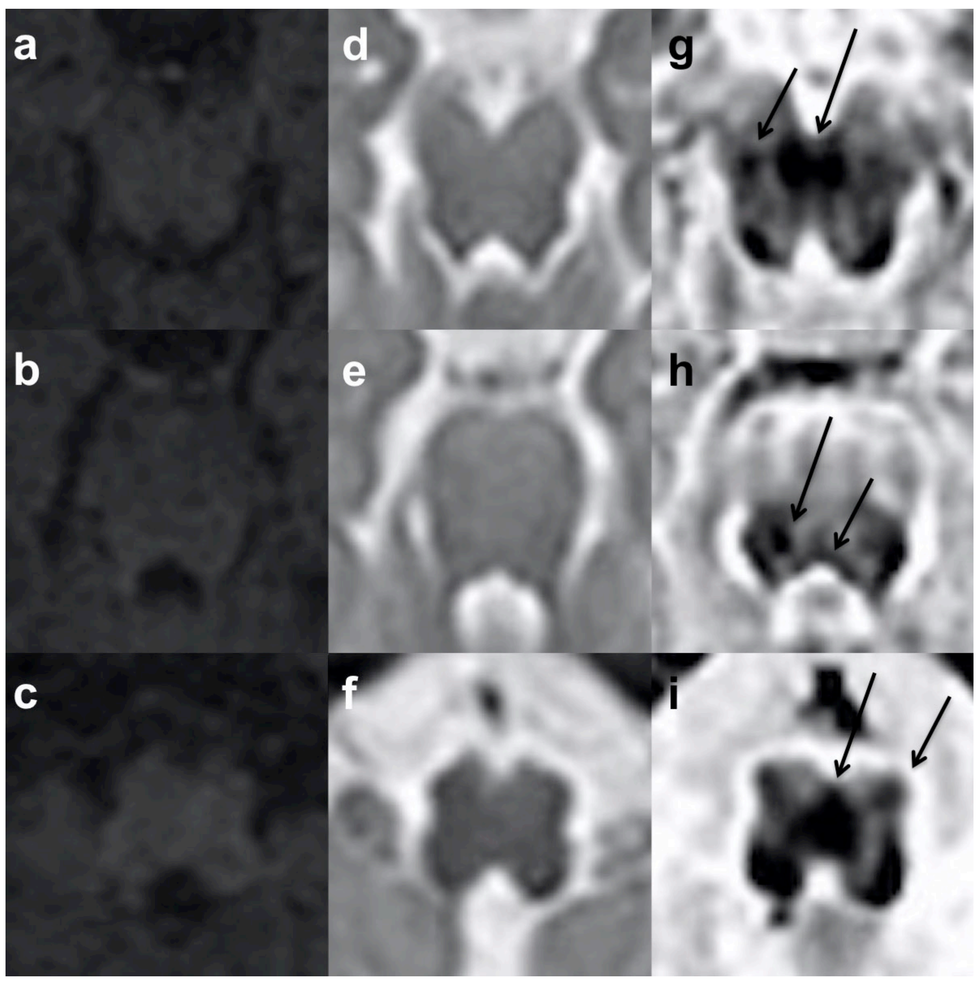

Fig.2: a, b, c) T1-weighted, d, e, f) T2-weighted, and g, h, i) FGATIR. FGATIR depicts brainstem tracts most reliable than T1-/T2-weighted imaging data: DSCP (g: long arrow); ML (g: short arrow, i: long arrow); CTT (h: long arrow); LMF (h: short arrow); inferior olivary nucleus (i: short arrow)

RESULTS:

SyMRI® provided FGATIR contrasts of diagnostic quality in 31/31 cases (100%).

Based on MDME-based FGATIR contrasts, the DSCP [31/31 (100%)]; left/right ML [31/31 (100%)]; left/right CTT [20/31 (65%)]; and left/right LMF [31/31 (100%)] were reliably identified.

Based on conventional T1-weighted contrasts, the DSCP [14/31 (45%)]; left/right ML [25/31 (81%)/23/31 (74%)]; left/right CTT [3/31 (10%)/7/31 (23%)]; and left/right LMF [15/31 (48%)] were reliably identified.

Based on conventional T2-weighted contrasts, the DSCP [30/31 (97%)]; left/right ML [30/31 (97%)/29/31 (94%)]; left/right CTT [26/31 (84%)/25/31 (81%)]; and left/right LMF [30/31 (97%)] were reliably identified.

CONCLUSION:

Synthetic generation of FGATIR contrasts enables radiological identification of neonatal brainstem pathway anatomy *in vivo*. The investigated MR approach depicts early myelinating tracts more reliable than standard-of-reference contrasts.

REFERENCES:

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2. Shepherd TM, Ades-Aron B, Bruno M, Schambra HM, Hoch MJ. Direct in vivo MRI discrimination of brain stem nuclei and pathways. *AJNR Am J Neuroradiol*. 2020;41(5):777–84.