The regional changes of Non-BBB Pituitary perfusion characteristics in idiopathic growth hormone deficiency patients by Dynamic contrast enhanced T1 MR Imaging: assess by Brix pharmaceutical model

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Purpose
To quantitatively investigate the regional perfusion characteristics of the pituitary gland by dynamic contrast-enhanced MR imaging in patients with idiopathic growth hormone deficiency (IGHD).

Materials and Methods
Twenty-five patients with clinical growth retardation and proven idiopathic growth hormone deficiency (16 male, 9 female; age 10.8±3.4 years) were enrolled. Fifteen children (7 male, 8 female; mean age 11.4±5.1 years) were included for normal control. Coronal T1-weighted dynamic contrast-enhanced MR images were acquired, from which the perfusion parameters of the pituitary glands were quantitatively derived using the Brix pharmacokinetic model. The pituitary gland height and anterior-posterior length were measured to ensure these glands are morphological normal. Perfusion properties were examined regionally on ten regions-of-interest, including the lower infundibulum stalk plus the center part and bilateral peripherals of the anterior pituitary gland in three continuous slices. Linear regression correlation analysis was performed to evaluate the correlation between the growth hormone level and the changes of perfusion parameters. Significance in statistical difference was examined using two-tailed Student t test.

Results
The pituitary gland height and anterior-posterior length are 5.1±0.8mm and 6.3±0.7mm in IGHD, control groups are 6.2±1.2mm and 7.3±0.8mm which are all on the normal gland size range. The time-to-peak (TTP) for the dwarfism group was significantly prolonged than normal control (p<0.005)(Fig.1). The trend of delayed TTP was found to be global, showing faster contrast arrival in the central (40.4 vs. 65.7 sec for normal and dwarfism groups, respectively) than in the peripheral parts (63.6 vs. 104.6 sec for normal and dwarfism groups, respectively). Maximal signal enhancement(Cmax) showed no significant difference between the two groups. We also observed that contrast medium transfer rate (k21) of dwarfism group is slower than normal group in median and bilateral (P<0.05), both group have higher k21 constant than bilateral. Elimination transfer rate constant (Kel) in both group exist no significant difference. Linear regression analysis reveals that the GH levels are negatively correlated with the maximum signal intensity(Cmax) in idiopathic growth hormone deficiency patients (P<0.05, R²=0.297)(Fig.2).

Conclusion
Significantly delayed enhancement of the entire anterior pituitary indicates that the perfusion impairment in pituitary dwarfism is global, not correlating with anatomical secretion locations of somatotrophin cells that are more lateral. The results suggest that the intrinsic blood supply in anatomically normal pituitary may account in part for the reduced supply for the growth hormone. Multiple perfusion parameters (TTP, amplitude, slope and K21) were found center enhance first then bilateral, posterior part of anterior pituitary gland first then anterior part.

Figure 1. Pituitary regional TTP of perfusion parameter comparison in both groups. We observed that enhance delayed were occurred in global 10 ROIs of idiopathic growth hormone deficiency patients. No specific deficiency perfusion can be found in somatotrophin cells secreting area.

Figure 2. After Brix model analysis, we correlate the growth homone level with the perfusion parameters and found peak enhancement (Cmax) is negative correlation (R²=0.297) with significant.