Functional assessment of hypopituitarism: Novel perfusion criteria using radial-VIBE sequence with GRASP technique

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INTRODUCTION: Conventional dynamic pituitary MR imaging is routinely employed to evaluate for pituitary microadenomas (focal areas of differential enhancement), and macroadenomas (gland abnormally increased in size) in patients with endocrinologic disturbances. However, often times a normal-sized pituitary gland with no focal areas of differential enhancement is seen in patients with endocrine disturbances suspected to be of central origin[1].
We hypothesize clinical hypopituitarism without any structural abnormality could be associated with abnormal perfusion of the pituitary gland. The purpose of our study was to evaluate the perfusion parameters using radial VIBE with GRASP in patients with "central" endocrine disturbances and a normal appearing pituitary gland.

METHODS: A retrospective HIPAA compliant study was performed in 43 patients (M:F =14:29). Of these, Group 1 consisted of 33 patients (M:F=9:24; mean age 41±13) in which evaluation for normal perfusion characteristics was performed from normal appearing anterior and posterior pituitary glands. This formed the control group. Group 2 consisted of 10 patients (M:F=5:5; mean age 35±20) with clinical features and laboratory evaluation consistent with hormonal deficiency of suspected central "pituitary" origin, and no morphological abnormalities on routine dynamic MR imaging. All 43 patients were evaluated on a 3 T (Siemens MAGNETOM Trio/Skyra). GRASP data was acquired during the administration of 0.01 mmol/kg of gadolinium-based contrast at 3 mL/second (20 sec after initiation). The following acquisition parameters were used: 0.7 mm in-plane resolution and 1 mm slice thickness, 32 slices, 180 mm FOV, FA 9.5°, BW 391 Hz/pixel, TE/TR=2.4/6.4 ms, 256 pixel base resolution, 944 spokes, and 164 sec acquisition time. ROI-based signal-enhancement curves were generated using the OLEA Sphere 2.2 software to obtain signal-time curves (STCs) from the anterior and posterior pituitary gland. Statistical analysis was performed using Mann Whitney (MW) test to evaluate the mean area under the curves (AUC), mean peak, mean time of maximum enhancement (TME), mean washin and washout parameters for the anterior and posterior pituitary glands between the two patient groups.

RESULTS: Evaluation of STCs from the anterior pituitary and posterior pituitary gland showed different patterns of enhancement between the two groups. STCs from anterior and posterior pituitary gland demonstrated a statistically significant difference ($p < 0.05$) in the AUC, peak, washin and washout parameters (Fig. 1) (Table 1) between the patient population when compared to the control group. No significant differences were observed in TME values between the two groups.
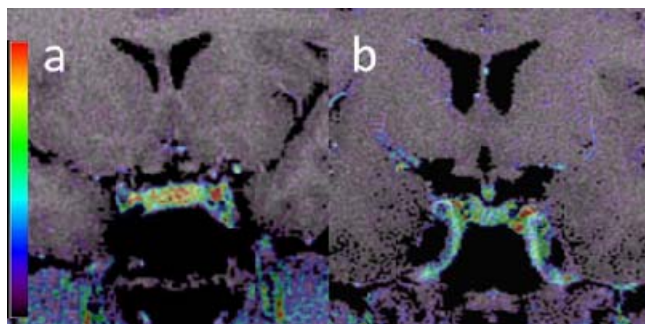
DISCUSSION: Routine dynamic conventional imaging of the pituitary gland allows for only morphologic evaluation. Imaging functional information from the pituitary gland when no structural abnormality is present has not been explored. Radial VIBE with GRASP has demonstrated its utility in evaluating structural perfusion metrics[2-3]. However, its role in evaluating the pituitary gland has not been explored. In this study, using the radial VIBE with GRASP technique, we demonstrate that patients with suspected central hypopituitarism without any structural abnormalities show significant differences in the perfusion characteristics of the underlying abnormal pituitary gland. This finding is supported by studies in the literature which have demonstrated an intimate association between changes in pituitary perfusion following functional stimulation[4].

Fig.1 Exemplary GRASP images merged with peak maps in controls (a) and patients with pituitary hormonal deficiency (b) demonstrate significant lower peak enhancement values in the patient population, as shown by the color scale. Pl refer to Table 1.

CONCLUSIONS: Relative hypoperfusion is present within the "normal appearing pituitary gland" in patients with "central" endocrinologic disturbances. According to our literature research, this is the first imaging study investigating a hypofunctioning pituitary gland using perfusion based metrics.

Measure	Region	Group 1 (N=33)			Group 2 (N=10)			P Values
		Mean	SD	Median	Mean	SD	Median	MW
AUC	Anterior	71238.33	22333.06	67611.49	49954.57	23953.03	46134.14	0.027
AUC	Posterior	42085.19	21353.77	39752.43	22828.02	12330.78	22266.33	0.008
PEAK	Anterior	786.69	241.82	791.55	511	214.8	500.83	0.005
PEAK	Posterior	498.39	223.46	456.4	243.22	114.32	223.15	0.001
TME	Anterior	87.14	19.61	88.85	83.06	22.17	79.23	0.618
TME	Posterior	60.77	13.11	59.08	56.36	20.54	54.72	0.54
WASHIN	Anterior	11.27	3.75	11.08	7.88	3.07	8.49	0.018
WASHIN	Posterior	9.12	3.59	8.07	6.74	4.01	5.96	0.049
WASHOUT	Anterior	2.13	1.76	1.7	1.24	1.37	0.71	0.046
WASHOUT	Posterior	2.5	1.39	2.09	1.12	1.22	0.87	0.001

Table 1. The mean, SD and median of each perfusion measure between the two groups is shown.
P values are from unequal variance t tests and Mann-Whitney (MW) tests comparing the two groups in terms of each regional measure.

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