

# Detection of intracellular lipid in adrenal adenomas - a direct intra-individual comparison of chemical shift imaging of adrenal lesions imaged at both 1.5T and 3T.

Justin M Ream<sup>1</sup>, Byron Gaing<sup>1</sup>, Thais C Musci<sup>2</sup>, and Andrew B Rosenkrantz<sup>1</sup>

<sup>1</sup>Radiology, NYU Langone Medical Center, New York, NY, United States, <sup>2</sup>Hospital Israelita Albert Einstein, Sao Paulo, Brazil

**Introduction:** Chemical shift MRI is well-established for detecting intracellular lipid in adrenal adenomas<sup>1</sup>. However, past studies have largely been performed at 1.5T. The faster cycling time and difficulty in achieving consecutive TEs at 3T may hinder its diagnostic performance for this purpose. While a limited number of studies have shown dual-echo T1WI at 3T to have adequate performance in diagnosing adrenal adenomas<sup>2-5</sup>, including one study comparing 1.5T and 3T MRI between different patients groups<sup>2</sup>, the accuracy of 1.5T and 3T MRI in diagnosing adrenal adenomas has not been compared within the same set of adrenal lesions. Thus, the aim of this retrospective study is to perform an intra-individual comparison of 1.5T and 3T MRI in diagnosing adrenal adenomas.

**Methods:** In this IRB-approved study, we searched radiology reports for adrenal masses that underwent MRI on separate dates at 1.5T (opposed-phase and in-phase TE of 2.2 ms and 4.4 ms, respectively) and 3T (opposed-phase and in-phase TE of 1.1 ms and 4.4 ms, respectively). 37 adrenal masses in 36 patients were included: 27 benign adenomas in 27 patients, defined as solid adrenal lesions with intracellular lipid or >24 months of stability; and 10 non-adenomas in 9 patients, including 8 metastases (4 from hepatocellular carcinoma, 3 from lung cancer, and one from sarcoma), one pheochromocytoma, and one neurogenic tumor. Two radiologists, blinded to diagnosis and field strength, independently recorded whether each lesion showed visual signal loss between in- and opposed-phase T1WI at each field strength. One reader placed circular regions of interest (ROIs) on each lesion, as well as in spleen, liver, and paraspinal muscle, in both in- and opposed-phase images at 1.5T and 3T, and recorded mean signal intensity (SI) of each ROI to compute SI-index, adrenal-to-spleen ratio, adrenal-to-liver ratio, and adrenal-to-muscle ratios [3]. McNemar tests and ROC analyses were used to compare performance at 1.5T and 3T in diagnosing adrenal adenomas.

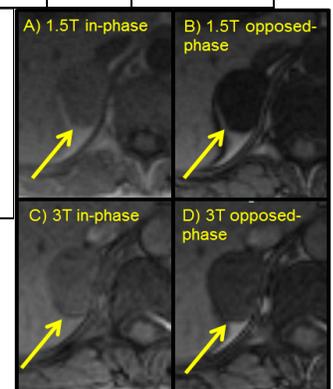
**Results:** Using visual signal loss, both readers had similar accuracy (R1: p=1.000; R2: p=0.178) and sensitivity (R1 and R2: p=1.000) for diagnosing adrenal adenomas at 1.5T and 3T. Performance at both 1.5T and 3T was generally higher using the quantitative metrics compared with visual assessment. None of the four quantitative measures showed a significant difference in performance between 1.5T and 3T (p≥0.118). ROC analysis identified markedly lower thresholds for diagnosing adenomas at 3T than at 1.5T. Of note, optimal SI-index was 7.4% at 3T, compared with 26% at 1.5T. However, sensitivity and specificity of the SI-index when applying these thresholds was similar between field strengths (1.5T: 89% and 90%, respectively; 3T: 93% and 90%, respectively). (Fig. 1, Table1)

**Table 1: Comparison of 1.5T and 3T MRI in Differentiation of Adrenal Adenomas and Non-adenomas**

Parameter	1.5T				3T				p-value (AUC/acc. 1.5T vs. 3T)
	AUC/acc.	Optimal threshold	Sens.	Spec.	AUC/acc.	Optimal threshold	Sens.	Spec.	
Visual (reader 1)	87%	-	85%	90%	81%	-	82%	80%	1.000
Visual (reader 2)	81%	-	85%	70%	84%	-	85%	80%	0.178
Signal intensity index	0.956	> 26.1%	93%	90%	0.915	> 7.4%	89%	90%	0.352
Adrenal-to-spleen ratio	0.963	< -35.9%	93%	90%	0.870	< -17.2%	85%	90%	0.133
Adrenal-to-liver ratio	0.935	< -32.6%	92%	90%	0.852	< -24.5%	77%	100%	0.118
Adrenal-to-muscle ratio	0.948	< -29.3%	93%	90%	0.948	< -39.6%	89%	90%	1.000

**Discussion:** To our knowledge, this is the first study directly comparing dual-echo T1WI at 1.5T and 3T in characterizing adrenal lesions within the same patient cohort. Although attempting to apply thresholds previously established at 1.5T may result in misdiagnosis for some lesions at 3T, our data show that comparable accuracy may be achieved when using a lower threshold at 3T. This difference in threshold likely relates to a combination of the difference in cycling time of water and lipid protons at 3T, as well as the use of a different echo-pair combination than at 1.5T. Regardless of field strength, higher sensitivity is achieved via a quantitative, rather than visual, assessment. Our findings require validation in larger cohorts.

**Figure 1:** In and opposed phase T1WI at 1.5T (A and B, respectively) show a right adrenal lesion with signal intensity index (SII) of 62%, consistent with an adrenal adenoma. On in and opposed phase T1WI at 3T (C and D, respectively), lesion shows a lower SI of 26%.



**Conclusion:** 3T MRI provides similar diagnostic performance as 1.5T MRI for differentiating adrenal adenomas and non-adenomas, although requiring a lower threshold for detection of intracellular lipid in adenomas.

**References:** [1] Israel GM et al. AJR 2004;183:215. [2] Nakamura S et al. JMIR 2012;35:95-102 [3] Schindera ST et al. Radiology 2008;248:140-7. [4] Marin D et al. Radiology 2010;254:179-87. [5] Song J et al. EJR 2012;81:2137-43.