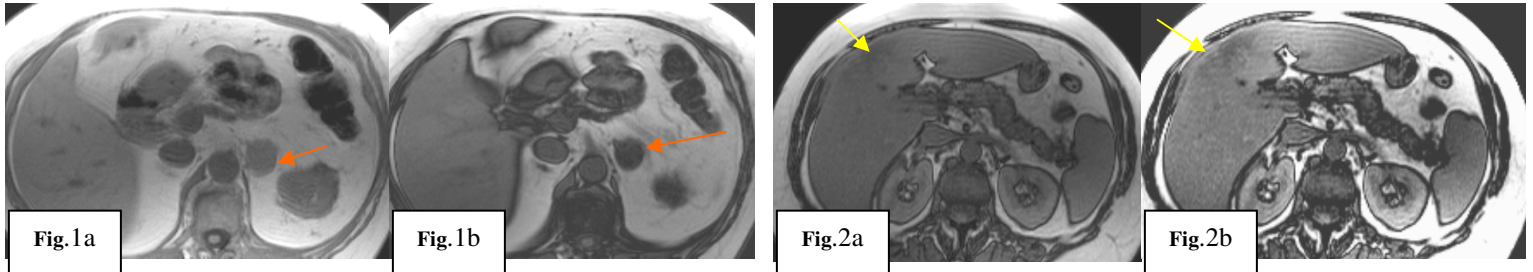


IN-PHASE & OUT-OF-PHASE MR IMAGING
Value in the Diagnosis of Abdominal Abnormalities



CASE #1: The patient in Figures 1a-1b presented with a left adrenal mass on a CT scan. The question was whether or not this represented a benign adenoma or other solid adrenal tumors including a malignancy.

CASE #2: The patient in Figures 2a-2b presented with a possible right lobe liver mass on a CT. The question was whether or not this represented a benign focal fatty infiltration (FFI) or a solid hepatic tumor including a malignancy.

IMAGING FINDINGS:

PATIENT #1: CT images (not shown) demonstrated a low density left adrenal mass with some enhancement. The CT density on precontrast images was around 0 HU (near water density), which is typically seen with adenomas. The MR image (**Fig. 1a**) shows the mass to be of intermediate signal intensity during in-phase T1W images (red arrow), which is nonspecific. However, during **out-of-phase** images (**Fig. 1b**), the mass became darker, indicating the presence of **fatty metamorphism** typically seen with a non-functioning adenoma. Diagnosis of an adenoma can be comfortably made with this technique.

PATIENT #2: CT images (not shown) demonstrated an ill-defined low-density area in the right lobe of the liver. A mass could not be excluded. The MR image (**Fig. 2a**) shows the area to be barely visible and of subtle low-to-intermediate signal intensity on in-phase T1W images (yellow arrow), which is nonspecific. However, during **out-of-phase** images (**Fig. 2b**), the area became darker, indicating the presence of **fatty component** typically seen with focal fatty infiltration.

DISCUSSION: Out-of-phase MR imaging relies on the principle that the protons in water and fat resonate at a slightly different frequency (220 Hz at 1.5 Tesla to be exact). This difference is exploited to cause the fat and water protons to be exactly “out-of-phase”, thus canceling each other out and causing a darker image. This is accomplished by varying the so-called echo-time (TE). At 1.5 Tesla, fat and water protons are “in-phase” at TE’s of about 0, 4.4, 8.8 msec, etc. and “out-of-phase” at TE’s of about 2.2, 6.6 msec, etc *. Out-of-phase MR images typically have a dark border around the organs (“boundary effect”) such as seen in **Fig. 1b, 2b**. Other fat-containing lesions can be diagnosed in the same manner.

For more information regarding the above or any other questions, please give us a call at any one of our three locations.

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* **REFERENCE:** Ray H. Hashemi, William G. Bradley, Christopher Lisanti. **MRI: The Basics, 2nd Edition.** Lippincott, Williams &Wilkins, 2004, pp 196-197.