Pericardial effusion is a common finding during routine cardiac imaging. In a large population-based study, prevalence exceeded 15% in the oldest cohort [1]. Additionally, an incidental discovery of pericardial effusion may provide significant clues to underlying disease and therefore, be an important tool in delineating prognosis [2,3].

A typical cardiac MRI examination includes an evaluation of myocardial function using steady-state free precession (SSFP) cine and myocardial viability with gadolinium-enhanced magnitude-reconstructed inversion recovery (Mag-IR). Despite markedly different T1 properties, SSFP and Mag-IR demonstrate poor contrast between pericardial effusion and epicardial fat, potentially obscuring the accurate identification of pericardial effusion.

Phase-sensitive inversion recovery (PS-IR) is a recently validated technique for detecting myocardial infarction [4]. Unlike Mag-IR, PS-IR eliminates background phase and preserves the sign of the desired magnetization during inversion recovery [5,6]. It is not as sensitive to the selected inversion time (TI), thereby decreasing the chance of a reduction in contrast due to a sub-optimal TI. As PS-IR maintains the polarity of short and long T1 tissues, the aim of the present study was to determine the ability of PS-IR to better differentiate pericardial effusion from epicardial fat compared with conventional SSFP and Mag-IR imaging.

**METHODS**

**Study Population:** Patients referred for a clinical cardiac MRI examination at either the National Institutes of Health or Suburban Hospital.

**Imaging Protocol:** Imaging was performed using a GE Sigma CVi 1.5T MRI system and a four-element cardiac phased array. In general, SSFP (short- and long-axis) was the first sequence acquired following scout images. Following a cumulative dose of 0.2 mmol Gd-DTPA per kg body weight, a stack of short-axis slices was acquired in all patients for inversion recovery.

**Imaging Sequences:**
- **Steady State Free Precession (SSFP):** 8mm slices in short- and long-axis at a temporal resolution of 40-50 ms and an in-plane spatial resolution of 1.8-2.0.
- **Gadolinium-Enhanced Inversion Recovery (Mag-IR and PS-IR):**

A fast gradient-recalled echo pulse sequence was used with interleaved phase-encode ordering. A nonselective adiabatic IR pulse was applied every other heartbeat. Images were acquired in mid-diastole using a prospectively gated segmented acquisition of k-space over twelve heartbeats during a single breath-hold. For phase sensitive reconstruction (PS-IR) a background reference image was obtained at the same cardiac phase on alternate heartbeats. Using PS-IR, the fat is bright (positive) but the effusion is dark (negative) (p<0.001). These findings are displayed in Figure 3. Representative images using the three sequences are displayed for all effusion sizes in Figure 4A. A patient with a large pericardial space filled with epicardial fat is visualized by each of the three sequences in Figure 4B.

**Data Analysis:**
- Region-of-interest (ROI) measurements were made to measure signal intensity of blood, myocardium, epicardial fat, pericardial effusion, and noise. Signal intensity of blood was measured in the left ventricular cavity. For myocardium, only viable segments were used. Contrast-enhanced myocardium was not measured. Epicardial fat was typically measured in the interventricular groove. Pericardial effusion was measured in the most pronounced effusive region. Noise was calculated for SSFP and Mag-IR signal intensity correction.

**RESULTS**

**Effusion Prevalence**
From this retrospective series of 392 consecutive patients, 53 patients had a pericardial effusion. The effusions were classified as small (42 patients), moderate (8 patients), and large (3 patients) using standard echocardiographic semi-quantitative measurements [3]. Of the 42 patients diagnosed with a small effusion, 28 of the effusions were less than 5mm in size.

**Image Analysis**
The signal intensity of fat and effusion were similar using SSFP (p=NS) or Mag-IR (p=NS). However, the fat is bright (positive) but the effusion is dark (negative) (p<0.001). These findings are displayed in Figure 3. Representative images using the three sequences are displayed for all effusion sizes in Figure 4A. A patient with a large pericardial space filled with epicardial fat is visualized by each of the three sequences in Figure 4B.

**DISCUSSION**
SSFP cine MRI and conventional gadolinium-enhanced infarct images (Mag-IR) do not adequately discriminate between pericardial effusion and epicardial fat despite the large difference in T1. Phase sensitive reconstruction of the same gadolinium enhanced infarct images (PS-IR) provides high quality delayed hyperenhancement images and easily differentiates effusion from fat. PS-IR does not lengthen the typical exam or acquisition time compared with conventional 2RR triggered IR infarct methods [7].

**REFERENCES**