

# Balanced Gradient Echo (FIESTA)- MRI Evaluation Of The Fatty Liver Disease

**Fatih Düzgün**, Asistant Professor, Celal Bayar University Medicine School Radiology Department, Manisa, Turkey. email: [fatihdzgn@yahoo.com](mailto:fatihdzgn@yahoo.com) , phone: 90 505 252 96 63

**Gökhan Pekindil**, Professor, Celal Bayar University Medicine School Radiology Department, Manisa, Turkey. email: [pekindilg@yahoo.com](mailto:pekindilg@yahoo.com) , phone: 90 533 415 06 61

## Corresponding Author:

**Fatih Düzgün**

Güzelyurtmah. 5789 sok. Atlantis 2 Sitesi C blok d:2

Yunusemre/Manisa

[fatihdzgn@yahoo.com](mailto:fatihdzgn@yahoo.com)

Phone: +90 505 252 96 63

Fax: +90 236 2349070

## Abstract:

**FIESTA** (Fast Imaging Employing Steady-state Acquisition) is commonly accepted that belong to the class of gradient-echo sequence (1). FIESTA has proved to be useful in abdominal imaging for magnetic resonance imaging (MRI) of gastrointestinal system, oncologic imagings, assessing vascular patency. However, FIESTA MRI findings of fatty liver has not previously been reported, although it described the signal reduction due to fat in previous articles.

We observed that the patients with fatty liver had lower signal intensity (SI) values at FIESTA sequences compared to normal patients without fatty liver.

## Materials and methods:

Thirty patients with liver fat and thirty patients without fatty liver were the control group. Thirty patients who had detected fatty liver at T1W in-out of phase MRI (IOP-MRI) images were evaluated with coronal FIESTA sequence at 1.5 Tesla scanner. All patients were obtained FIESTA sequence using the same MRI acquisition parameters. Liver and spleen SI's were measured as using same ROI on coronal FIESTA sequences and liver to spleen SI ratio were calculated. All values were compared.

## Results:

Decrease in SI of the fatty liver on FIESTA images is negatively correlated with the fatty fraction of the liver. Patients with fatty liver had liver / spleen SI ratio from 0.15 to 0.71 (mean 0.39), and 0.41 to 0.96 in the control group (mean 0.70). There was a statistically significant difference.

**Conclusion:**

*We believe suggest that balanced gradient echo sequences such as FIESTA, can detect fatty liver however further studies are required to evaluate the capability of these sequence in evaluation of fatty fraction of the liver.*

*Keywords: MRI, FIESTA, gradient-echo sequence, fatty liver*

**Introduction:**

FIESTA (balanced FFE, True FISP, True SSFP, BASG) is commonly accepted that belongs to the class of gradient-echo sequence (1). FIESTA has proved to be useful in abdominal imaging for magnetic resonance imaging of small bowel follow-through (duodenal abnormalities including volvulus) and MRI enteroclysis, MRI colonography, oncologic imaging (especially useful in retroperitoneal tumor and pancreatic carcinoma due to its excellent depiction of vascular anatomy) and assessing vascular patency (portal vein). It is compared with single-shot fast spin echo (SSFSE), a commonly used sequence in abdominal MRI (2-7). Although it is known that FIESTA sequence can show intracellular lipid, fatty liver disease has not previously been evaluated.

We observed that the patients with fatty liver had lower signal intensity (SI) values at FIESTA sequences that we compared findings of the cases with and without fatty liver in this study.

**Materials and method:**

Thirty patients with fatty liver and thirty patients control group without fatty liver were included in the study. Thirty patients who had detected fatty liver at T1W in-out of phase MRI (IOP-MRI) images were evaluated with coronal FIESTA sequence at 1.5 Tesla scanner (GE Healthcare, Milwaukee). The axial double echo GRE images of all patients were evaluated and the hepatic fat fraction (HFF) was calculated using the two-point Dixon method by looking at the fatty liver and control liver groups separately. Control group <5% HFF patients and fatty liver group >5% HFF patients were included. It was evaluated for the input-output phase images to confirm signal loss in the fatty liver group.

All patients were obtained FIESTA sequence using the same MRI acquisition parameters. Acquisition parameters were as follows; scan timing (TE: Min Full, Flip angle: 70, bandwidth: 83,33) ; Acquisition timing ( freq: 256, phase: 288, Nex: 1, phase FOV: 1, Acqs before pause: 10); scanning range ( FOV: 40, slice thickness: 7, spacing: 1).

Liver and spleen SI's were measured as using same ROI (300-310 mm<sup>2</sup>) on coronal FIESTA sequences and liver to spleen SI ratio were calculated. These values were compared in cases with and without hepatic steatosis. Moreover, SI of the liver were also compared in cases with and without fatty liver.

**Results**

Patients with fatty liver had with hepatic fat fraction ratio of 4.5-44% (mean 23%) and cranio-caudal liver size was 15 to 25 cm (mean 18,9 cm).

Patients with fatty liver SI had was ranged from 32 to 178 (mean 78,2) for liver and from 86 to 403 for spleen. In control group, SI of the liver was ranged from 65 to 259 (mean 121,5). Decrease in SI of the fatty liver on FIESTA images is negatively correlated with the fatty fraction of the liver. Patients with fatty liver had liver / spleen SI ratio between 0.15 to 0.71 (mean 0.39), and between 0.41 to 0.96 in the control group (mean 0.70) and it was statistically significant (Two sample T- test).

### Discussion:

We observed that the patients with fatty liver had lower signal intensity values at FIESTA sequences compared to normal patients without fatty liver. Moreover, we did not find any articles on the use of FIESTA sequences in showing fatty liver in our literature review.

Fatty liver is the one of the most common liver disorders. It has been shown in recent studies that it affects 15% of the general population and has a higher rate with higher obesity and alcohol consumption (8-10). Conventional MRI can be used to detect fatty liver.

The IOP-MRI method uses the difference between the resonance frequencies between the water and fat proton signals and this provides MR imaging, which enables the expression of the fatty liver. Without-of-phase images, it is possible to detect liver fat due to relative signal loss by obtaining images in echo times when the water and fat signals are approximately opposite (11).

Although there are various imaging methods used to show liver fat, IOP imaging is considered as the noninvasive gold standard imaging method for the qualitative detection and characterization of fat in the liver. (12).

Chang JS et al. using phantom applications containing 30-70% fat and 40-60% fat showed that the fatty liver cannot be distinguished visually by IOP-MRI images (13). Out-phase imaging is known to be an accurate method for detecting microscopic fat; however, data on the use of counter-phase imaging for liver fat measurement are limited. (14-18).

Bhosale P. et al. said that tumors containing adipose tissue like that adenomas or angiolipomas can be characterized by a reduction in signal intensity with or without applying a fat suppression technique such as chemical shift selective saturation to the FIESTA sequence. The signal decline in fat containing tissue in the FIESTA sequence will have a similar demonstration as in IOP-MRI (6).

Since the FIESTA sequence can be used as an anatomical evaluation of the upper abdomen in most MRI studies, especially Magnetic Resonance Cholangiopancreatography (MRCP), this finding may be valuable in detecting fatty liver in cases that do not routinely contain the IOP-MRI sequence. FIESTA sequence is routinely obtained in all MRCP examinations in many institutions such as our department. In this way, fatty liver can be detected during MRCP examinations. Clinical benefit can be achieved by detecting fatty liver with MRCP, which is the desired examination for various liver biochemistry disorders. Thus, IOP sequences may not be required as an additional examination to show the fatty liver of the patients.

However our study has limitations such as corrected SI values have not been calculated, however using liver/spleen ratio can overcome this problem and can be useful. Therefore decreased SI of the liver detected on FIESTA sequences should raise the suspicion of the fatty liver in those cases and radiologists should be familiar with this finding.

With this study, we have shown for the first time that patients with fatty liver have lower signal intensity values in FIESTA sequences than control patients. The liver/spleen SI ratio also confirmed the same finding. Our results also showed that decrease in SI of the fatty liver on FIESTA images is negatively correlated with the fatty fraction of the liver.

In conclusion; our results showed that balanced gradient echo sequences such as FIESTA can detect fatty liver by revealing decrease SI of the liver. However further studies are required to evaluate the capability of these sequences in evaluation of fatty fraction of the liver.

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**FiguresLegends:**

**Figure 1:** Patient with fatty liver (A,B,C) and control patient (D). In phase (A)-out phase (B) shows that signal lost compatible with fatty liver (FFR: 36.52%). On FIESTA images patient with fatty liver (C) showed lower SI than control (D).

**Figure 2:** Patient with fatty liver (A,B,C) and control patient (D). In phase (A)-out phase (B) shows that signal lost and (HFF 9,54%). On FIESTA images patient with fatty liver (C) showed lower SI than control (D).

**Figure 3:** A, patient with fatty liver; B, control case. Liver/spleen SI ratio of patient with fatty liver (A) was higher than control (B) (0,75/ 0,66)