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BalancedGradientEcho (FIESTA)- MRI Evaluation Of TheFattyLiverDisease

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Abstract:

FIESTA (FastImagingEmployingSteady-stateAcquisition) is commonlyacceptedthatbelongstotheclass of gradient-echosequence (1). FIESTA has provedto be useful in abdominalimagingformagneticresonansimaging (MRI) of gastrointestinalsystem, oncologicimagings, assessingvascularpatency. However, FIESTA MRI findings of fattyliver has not previouslybeenreported, although it describedthesignalreductionduetofat in previousarticles.

Weobservedthatthepatientswithfattyliver had lowersignalintensity (SI) values at FIESTA sequencescomparedto normal patientswithoutfattyliver.

Materialsandmethods:

Thirtypatientswithliverfatandthirtypatientswithoutfattyliverwerethecontrolgroup.Thirtypatientswho had detectedfattyliver at T1W in-out of phase MRI (IOP-MRI) imageswereevaluatedwithcoronalFIESTA sequence at 1.5 Teslascanner. Allpatientswereobtained FIESTA sequenceusingthesame MRI acqusitionparameters. LiverandspleenSI'sweremeasured as usingsame ROI on coronal FIESTA sequencesandlivertospleen SI ratiowerecalculated. Allvalueswerecompared.

Results:

Decrease in SI of thefattyliver on FIESTA images is negativelycorrelatedwiththefattyfraction of theliver. Patientswithfattyliver had liver / spleen SI ratiofrom 0.15 to 0.71 (mean 0.39), and 0.41 to 0.96 in thecontrolgroup (mean 0.70). Therewas a statisticallysignificantdifference.

Conclusion:

Webelievesuggestthatbalancedgradientechosequencesuch as FIESTA, can detectfattyliverhoweverfurtherstudiesarerequiredforevaluatethecapability of thesequence in evaluation of fattyfraction of theliver.

Keywords: MRI, FIESTA, gradient-echosequence, fattyliver

Introduction:

FIESTA (balancedFFE,TrueFISP, True SSFP, BASG) is commonlyacceptedthatbelongstotheclass of gradient-echosequence (1). FIESTA has provedto be useful in abdominalimagingformagneticresonansimaging of smallbowelfollow-through (duodenalabnormalitiesincludingvolvulus) and MRI enteroclysis, MRI colonography, oncologicimaging (especiallyuseful in retroperitonealtumorandpancreaticcarcinomaduetoitsexcellentdepiction of vascularanatomy) andassessingvascularpatency (portal vein). It is comparedwithsingle-shotfastspinecho (SSFSE), a commonlyusedsequence in abdominal MRI (2-7). Although it is knownthat FIESTA sequence can showintracellularlipid,fattyliverdisease has not previouslybeenevaluated.

Weobservedthatthepatientswithfattyliver had lowersignalintensity (SI) values at FIESTA sequencesthatwecomparedfindings of thecaseswithandwithoutfattyliver in thisstudy

Materialsandmethod:

Thirtypatientswithfattyliverandthirtypatientscontrolgroupwithoutfattyliverwereincluded in thestudy. Thirtypatientswho had detectedfattyliver at T1W in-out of phase MRI (IOP-MRI) imageswereevaluatedwithcoronal FIESTA sequence at 1.5 Teslascanner (GE Healthcare, Milwaukee). Theaxialdoubleecho GRE images of allpatientswereevaluatedandthehepaticfatfraction (HFF) wascalculatedusingthetwo-pointDixonmethodbylooking at thefattyliverandcontrollivergroupsseparately. Control group<5% HFF patientsandfattylivergroup>5% HFF patientswereincluded. Itwasevaluatedfortheinput-outputphaseimagestoconfirmsignalloss in thefattylivergroup.

Allpatientswereobtained FIESTA sequenceusingthesame MRI acqusitionparameters. Acquisitionparameterswere as follows; scantiming (TE:Min Full, Flip angle:70, bandwith: 83,33) ; Acquisitiontiming (freq:256, phase:288, Nex:1, phase FOV:1, Acqsbefore pause:10); scanningrange (FOV:40, slice thickness:7, spacing:1).

LiverandspleenSI'sweremeasured as usingsame ROI (300-310 mm²) on coronal FIESTA sequencesandlivertospleen SI ratiowerecalculated. Thesevalues werecompared in caseswithandwithouthepaticsteatosis.Moreover, SI of theliverwerealsocompared in caseswithandwithoutfattyliver.

Results

Patientswithfattyliver had withhepaticfatfractionratio of 4.5-44% (mean 23%) andcraniocaudalliver size was 15 to 25 cm (mean18,9 cm).

Patientswithfattyliver SI had wasrangedfrom 32 to 178 (mean 78,2) forliverandfrom 86 to 403 forspleen. Incontrolgroup, SI of theliverwasrangedfrom 65 to 259 (mean 121,5).Decrease in SI of thefattyliver on FIESTA images is negativelycorrelatedwiththefattyfraction of theliver.

Patientswithfattyliverhad liver / spleen SI ratiobetween 0.15 to 0.71 (mean 0.39), andbetween0.41 to 0.96 in thecontrolgroup (mean 0.70) and it wasstatisticallysignificant (Twosample T- test).

Discussion:

Weobservedthatthepatientswithfattyliver had lowersignalintensityvalues at FIESTA sequencescomparedto normal patientswithoutfattyliver. Moreover, wedid not findanyarticles on theuse of FIESTA sequences in showingfattyliver in ourliteraturereview.

Fattyliver is theone of themostcommonliverdisorders. It has beenshown in recentstudiesthat it affects 15% of the general populationand has a higher rate withhigherobesityandalcoholconsumption (8-10). Conventional MRI can be usedtodetectfattyliver. The IOP-MRImethodusesthedifferencebetweentheresonancefrequenciesbetweenthewaterandfat proton signalsandthisprovides MR imaging, whichenablestheexpression of thefattyliver. Without-of-phaseimages, it is possibletodetectliverfatduetorelativesignallossbyobtainingimages in echotimeswhenthewaterandfatsignalsareapproximatelyopposite (11).

Althoughtherearevariousimagingmethodsusedtoshowliverfat, IOP imaging is considered as thenoninvasivegoldstandardimagingmethodforthequalitativedetectionandcharacterization of fat in theliver. (12).

Chang JS at al.usingphantomapplicationscontaining 30-70% fatand 40-60% fatshowedthatthefattylivercannot be distinguishedvisuallyby IOP-MRIimages (13).Out-phaseimaging is knownto be an accuratemethodfordetectingmicroscopicfat; however, data on theuse of counter-phaseimagingforliverfatmeasurementarelimited. (14-18).

Bhosale P.et al. saidthattumorscontainingadiposetissuelikethatadenomasorangiomyolipomascan be characterizedby a reduction in signalintensitywithorwithoutapplying a fatsuppressiontechniquesuch as chemicalshiftselectivesaturationtothe FIESTA sequence.Thesignaldecline in fatcontainingtissue in the FIESTA sequencewillhave a similardemonstration as in IOP-MRI (6).

Since the FIESTA sequence can be used as an anatomicalevaluation of theupper abdomen in most MRI studies, especiallyMagneticResonanceCholangiopancreatography (MRCP), thisfindingmay be valuable in detectingfattyliver in casesthat do not routinelycontainthe IOP-MRI sequence. FIESTA sequence is routinelyobtained in all MRCP examinations in manyinstitutionssuch as ourdepartment. Inthisway, fattyliver can be detectedduring MRCP examinations. Clinicalbenefit can be achievedbydetectingfattyliverwith MRCP, which is thedesiredexaminationforvariousliverbiochemistrydisorders. Thus, IOP sequencesmay not be required as an additionalexaminationtoshowthefattyliver of thepatients.

Howeverourstudy has limitationsuch as corrected SI valueshave not beencalculated, howeverusingliver/spleenratio can overhelmthis problem and can be useful.Thereforedecreased SI of theliverdetected on FIESTA sequenceshouldraisethesuspicion of thefattyliver in thosecasesandradiologistshould befamiliarwiththisfinding.

Withthisstudy, wehaveshownforthefirst time thatpatientswithfattyliverhavelowersignalintensityvalues in FIESTA sequencesthancontrolpatients. Theliver/spleen SI ratioalsoconfirmedthesamefinding. Ourresultsalsoshowedthatdecrease in SI of thefattyliver on FIESTA images is negativelycorrelatedwiththefattyfraction of theliver.

Inconclusion; ourresultsshowedthatbalancedgradientechosequencesuchas FIESTA can detectfattyliverbyrevealingdecreaseSI of theliver. Howeverfurtherstudiesarerequiredforevaluatethecapability of thesequence in evaluation of fattyfraction of theliver.

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FiguresLegends:

Figure 1: Patientwithfattyliver (A,B,C) andcontrolpatient(D). Inphase(A)-outphase(B) showthatsignallostcompatabilewithfattyliver (FFR: 36.52%). On FIESTA imagespatientwithfattyliver (C) showedlower SI thancontrol (D).

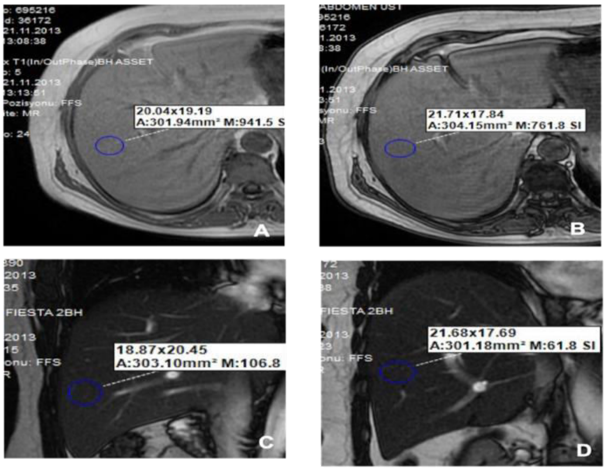

Figure 2: Patientwithfattyliver (A,B,C) andcontrolpatient (D). Inphase(A)-outphase (B) showthatsignallostand (HFF 9,54%). On FIESTA imagespatientwithfattyliver (C) showedlower SI thancontrol (D).

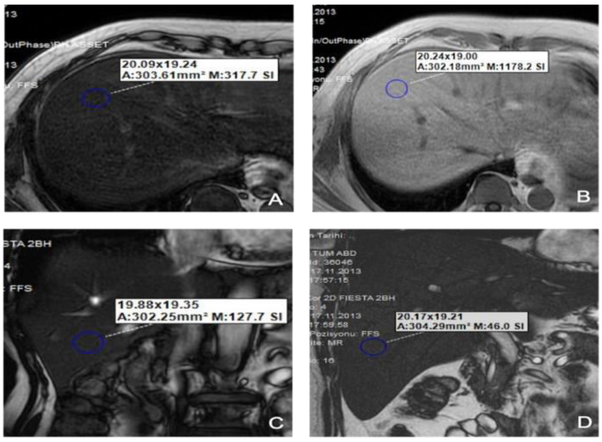

Figure 3:A,patientwithfattyliver; B, controlcase. Liver/spleen SI ratio of patientwithfattyliver (A) washigherthancontrol (B) (0,75/ 0,66)