

Can high-resolution T1W 3-Dimensional (3D) gradient recalled echo (GRE) with 2-Point Dixon derived fat-water separation (FLEX) replace conventional T1W Turbo Spin-Echo (TSE) imaging for assessment of prostate cancer?

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Purpose

T1W TSE is a critical component in prostate cancer (PCa) evaluation at MRI. This study assesses if high-resolution T1W GRE with 2-Point Dixon fat-water separation (FLEX) can replace conventional T1W TSE, potentially reducing examination time.

Methods

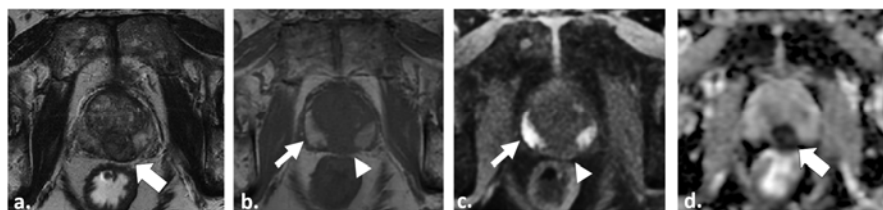
Under a quality assurance waiver from the IRB, 40 men (68, 51-91 years) underwent MRI of the prostate for staging of biopsy proven PCa. Imaging was performed using a 3 Tesla Discovery 750W system (GE Healthcare, Milwaukee WI) with integrated surface and spine array coils. In all patients, a modified free-breathing high resolution 2-Point Dixon (FLEX) T1W 3D GRE (LAVA) and conventional T1W TSE were performed. Pulse sequence parameters were: scan plane; axial, field of view; 32x38 and 36x36 cm, matrix; 320x320 and 320x320, slice thickness; 2.0 and 5 mm, gap; 1 and 0.6 mm, TR/TE; 7.7/1.9 and 850/7.2, flip angle; 10 and 90 degrees, bandwidth; 167 and 128 Hz, number of signals averaged; 1, acceleration; 2 and 0, echo train length; N/A and 3, approximate scan time; 80 and 240 sec. Two fellowship-trained abdominal radiologists independently assessed the T1W TSE and the water-only (WO) and fat-only (FO) images from FLEX-LAVA for: overall image quality, image sharpness (definition of neurovascular bundles), image contrast (clarity of post biopsy hemorrhage) and the presence and severity of artifacts (blur, phase encode [ghosting/wrap-around] and fat/water swap) using a 5 point scale. Results were compared between sequences using the Wilcoxon-sign rank test. Both radiologists also independently assessed for the presence of skeletal metastases and abnormal (>1 cm short axis) lymphadenopathy in two separate sessions separated by eight weeks. Skeletal or nodal metastases were present in 17 patients at the time of MRI and the sensitivity for their detection on each sequence was compared using the Fisher exact test.

Results

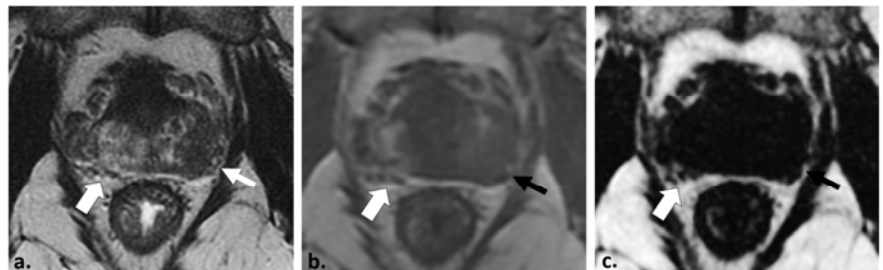
There was no difference in overall image quality comparing T1W TSE and FLEX-LAVA ($p=0.35$). In 38/40 patients image quality on FLEX-LAVA was rated as excellent by both readers. Image sharpness was considered better with FLEX-LAVA ($p=0.42$), with no difference in image contrast ($p=0.19$). There was less image blur on FLEX-LAVA ($p=0.001$) but no difference in phase encoding artifact ($p=0.63$). In 10 patients there was fat-water swap artifact on FLEX-LAVA which only resulted in mild artifact that did not compromise the diagnostic quality of the study. In two patients with bilateral hip prostheses, FLEX-LAVA was considered non diagnostic due to severe artifact from hardware. From the 17 patients with metastatic disease, there were 81 bone and 29 nodal metastases in total. There was no difference in PSA between patients with (20, 0.6-124 ng/mL) or without systemic disease (11, 4.4-43 ng/mL), ($p=0.13$). Although both readers detected slightly more lymph nodes with FLEX-LAVA, overall, there was no difference in detection of lymph nodes or bone metastases compared to T1W TSE ($p>0.05$).

Conclusion

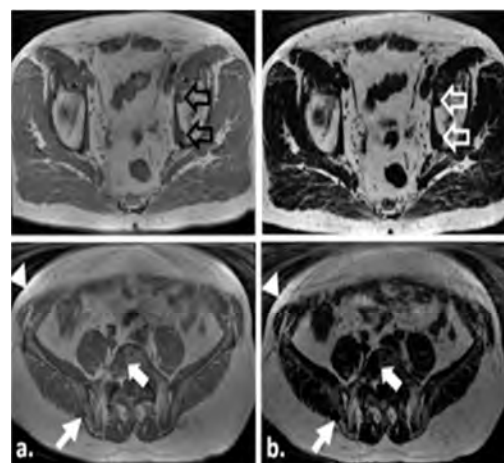
A high-resolution T1W GRE sequence with 2-Point Dixon derived fat-water separation provides similar diagnostic information to T1W TSE with comparable image quality and can therefore replace T1W TSE for the routine evaluation in prostate cancer thus saving time. In patients with a hip prosthesis, T1W TSE imaging is required.



64 year old male with Gleason score 4+5=9 PCa in the left mid medial peripheral zone (PZ). Axial T2W TSE (a) demonstrates a hypointense mass in the left PZ (white arrow). There is diffuse post-biopsy hemorrhage (white arrow) in the PZ on axial T1W TSE (b) with an area which is devoid of hemorrhage (arrowhead) in the location of the mass in (a). This is referred to as the "hemorrhage or MRI exclusion sign" of PCa and in combination with T2W findings has >90% accuracy for PCa detection. Axial T1W water only (WO) image obtained from 2-Point DIXON 3D GRE (c) demonstrates similar findings as (b) and was also rated of higher image quality with better image contrast and sharpness compared to (b) by both readers. Axial apparent diffusion coefficient (ADC) map (d) shows corresponding restricted diffusion in the tumor (white arrow).



59 year old male with Gleason score 4+3=7 PCa in the left basal lateral PZ. Axial T2W TSE (a) demonstrates T2 hypointense tumor (thin white arrow) with extracapsular extension and invasion of the left neurovascular bundle. The contralateral neurovascular bundle is uninvolved (thick white arrow). Axial T1W TSE (b) shows the normal right neurovascular bundle (thick white arrow) and no normal fascicles on the left with associated contour bulge (black arrow). Axial T1W fat only image obtained from 2-Point DIXON 3D GRE (c) demonstrates similar findings as (b) and was also rated of higher image quality with better image sharpness compared to (b) by both readers. Note improved delineation of the fascicles of the right neurovascular bundle (thick white arrow).



69 year old male with Gleason score 4+3=7 PCa and multiple bone metastases, confirmed on bone scan (not shown). Axial T1W TSE (a) demonstrates multiple bone metastases as low T1W signal intensity lesions in the predominantly fatty replaced marrow, for example: in the left acetabulum (open arrows), S1 vertebral body (white arrow) and right ilium (white arrow). Axial T1W fat only (FO) image obtained from 2-Point DIXON 3D GRE (b) demonstrates similar findings as (a) and was also rated of higher image quality with better image contrast and sharpness compared to (a) by both readers. Note phase encoding artifact from abdominal wall motion (arrow head) in both sequences which are acquired free-breathing set left-to-right which do not interfere with interpretation.