Case Report: Rectal Cancer Staging

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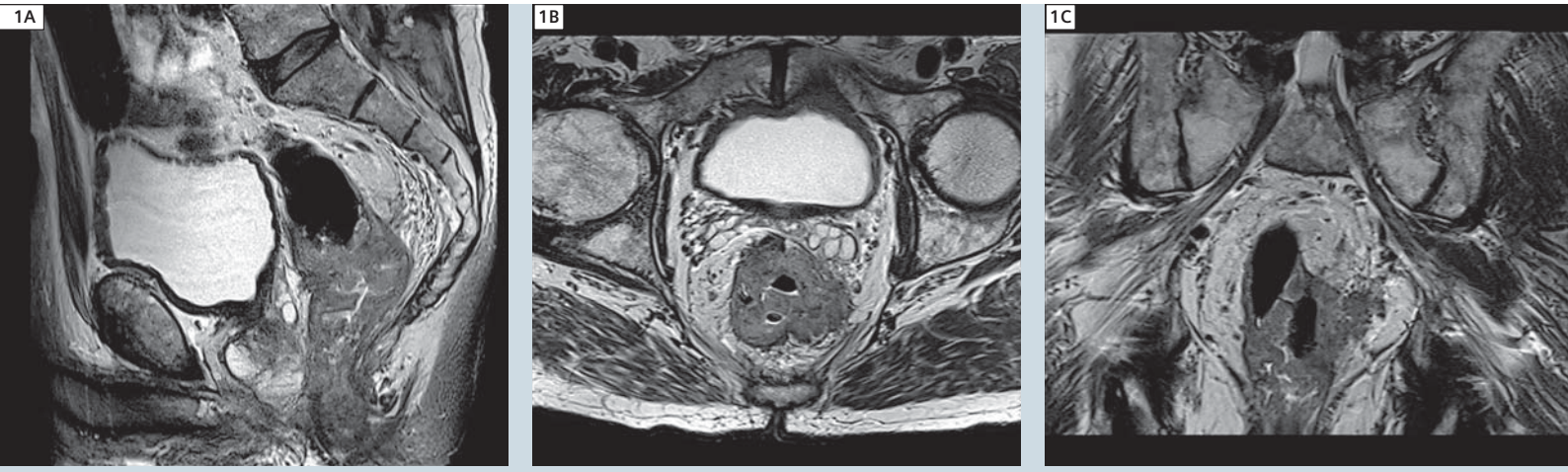
Patient history

The 71-year-old male presented with a 4 months history of diarrhoea, mild faecal incontinence and no per rectal (PR) bleeding. A proctoscope and a detailed examination under anesthesia (EUA) demonstrated tumor 7 cm from anal verge with no obstruction. Liver metastases had been identified on a CT scan performed elsewhere. Both the primary rectal tumor and the liver underwent MRI examination – the primary for formal anatomical staging, and the liver for assessment of the resectability, or otherwise, of the presumed metastases.
The rectal tumor was staged as T3 N0 M0, with extension through the margin of the mesorectal fascia on the left indicating a high risk of local recurrence after surgical excision.

Technique

Our rectal cancer protocol involves sagittal, axial and coronal T2-weighted Turbo Spin Echo (TSE) sequences of the pelvis.
The sagittal series are performed with a field-of-view (FOV) of 200 x 200. TR in the 4000 ms range and TE 90 ms with a resolution of 384 x 307. Scan time is 3 minutes.
We perform 2 series of T2 axials. The first is throughout the whole lesser pelvis at a slice thickness of 4 mm and 1.5 mm gap. The resolution is 320 x 240 at a FOV of 260 mm for this series. This gives 30 slices under 2 minutes. We then perform a higher resolution axial series through the lesion and angled at right angles to the bowel wall. This is to get the lesion in profile and better visualise local extension into the mesorectal fat. This sequence is performed at a FOV of 200 mm and slice thickness of between 2.5 and 3 mm with 0.3 mm gap. Resolution is 384 x 307. This is acquired in 3 minutes 20 seconds.
The coronal series is performed with a FOV of 220 mm and a slice thickness of 4 mm with a gap of 1.0 mm and a resolution of 384 x 284 in 3 minutes.
In this case the tumor demonstrates frank T3 tumor extension into the mesorectal fat on the left, with the tumor extension reaching and transgressing through the mesorectal fascia. The tumor has not yet reached the left pelvic side wall, although it involves at least one of the left internal iliac vessels. Along the left anterior lateral aspect, the

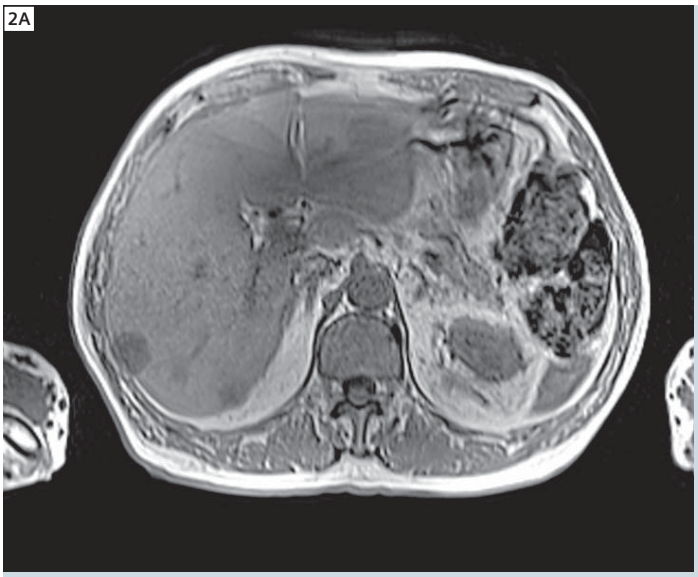


1 High-resolution T2-weighted TSE sequences used for local staging of rectal cancer. The tumor as well as all relevant anatomical structures for T-staging are visualized in detail including the mesorectal fascia. Slice orientation **1A** sagittal, **1B** transversal, **1C** coronal angulation).

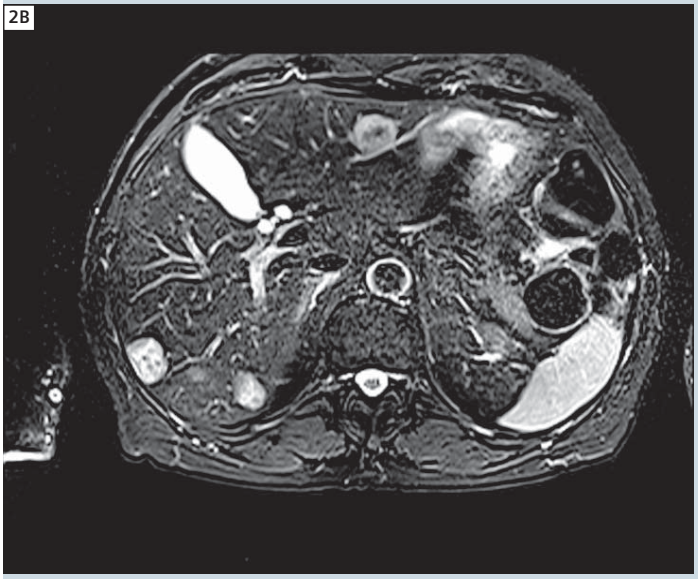
tumor extends to about the left seminal vesicle although no definite evidence of tumor extension into the seminal vesicle has been seen.
If the tumor does extend into seminal vesicles it would be a T4a tumor. There were multiple suspicious nodes visualised indicating at least T3D disease.
The MRI examination of the liver was enhanced by use of gadoxetate (Primovist), a contrast agent approximately 50 % of which is taken up by hepatocytes, and later excreted into the bile. The use of this agent increases the liver:lesion contrast ratio in images obtained more than 15 minutes after contrast injection, and hence increases sensitivity for non-hepatocytic lesions, such as metastases.

Technique

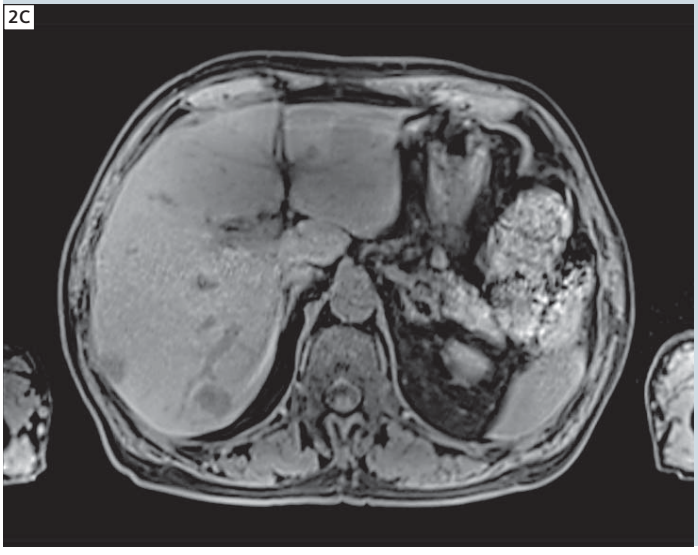
A 3D gradient echo technique, VIBE, was used for the contrast-enhanced images, allowing thin sections and rapid coverage of the whole liver during each of the phases of contrast enhancement. Enhancement can be made more conspicuous by the use of inline subtraction of a pre-contrast mask image.
For the T1-weighted VIBE in and out of phase breath-hold we used a FOV 300 x 400, 2 mm no gap. The TE used was 2.5 ms and TR 5.5 ms. This is a 21 second breath-hold for 192 images.
The next sequence was a T2-weighted TSE respiratory triggered with fat sat. This was with a FOV of 285 x 380 and 168 x 320 resolution. The time for this acquisition is approximately 2 minutes.
For the T1-weighted VIBE fat-sat breath-hold we use a FOV of 300 x 400, 2 mm no gap. The TR is 4 ms TE 1.4 ms at a resolution of 168 x 32.
Liver metastases from colorectal carcinomas are typically hypointense, relative to normal liver, on T1-weighted images, and mildly hyperintense on T2-weighted, fat-suppressed images. In the arterial phase of contrast enhancement, these lesions show irregular marginal enhancement, which becomes indistinguishable from the rest of the normal liver parenchyma in the venous and interstitial phases.



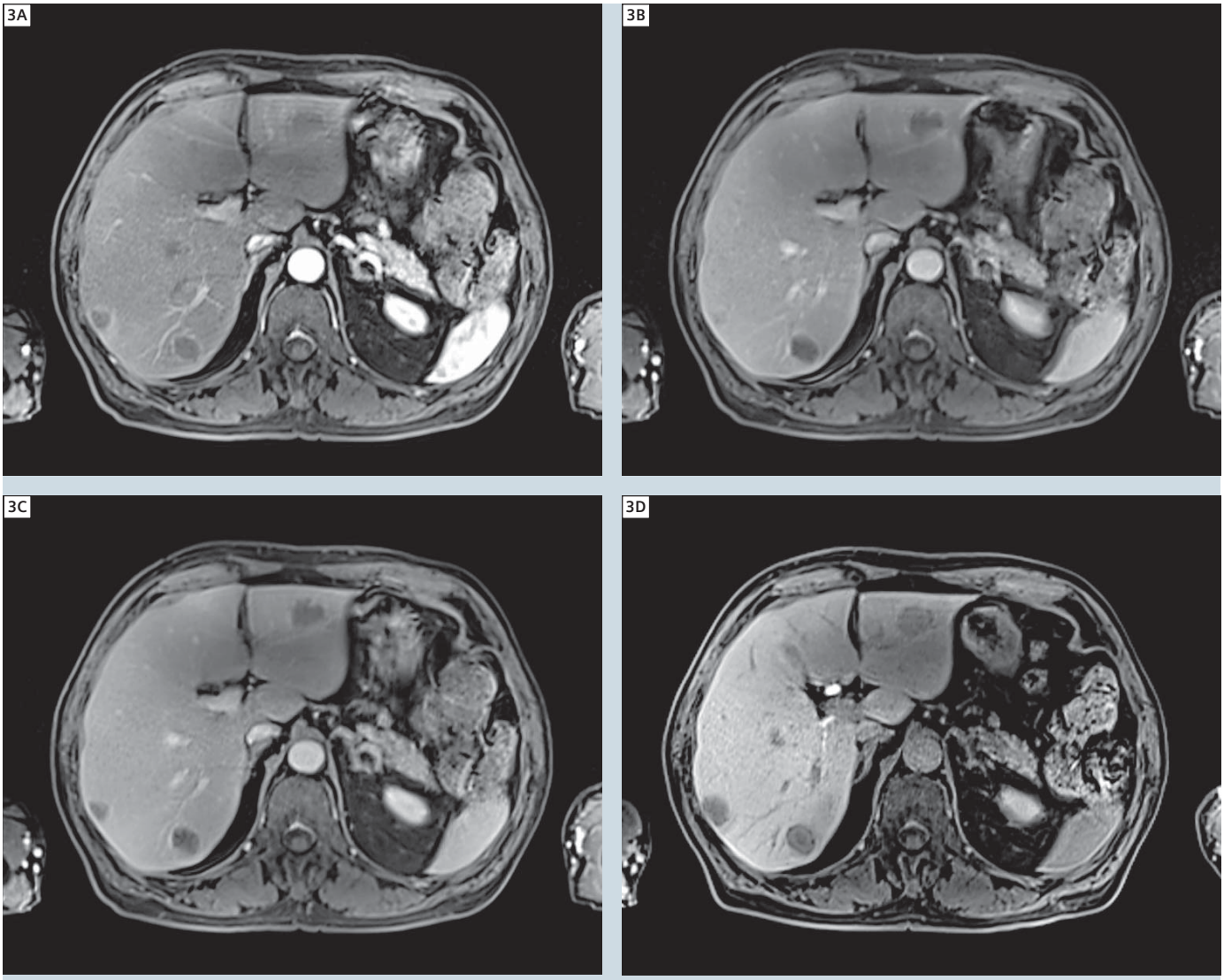
2 Native MR sequences used for M-staging of liver metastases. **2A** T1-weighted VIBE in and out of phase (in phase is shown).



2B T2-weighted TSE with respiratory gating (PACE).



2C Native T1-weighted 3D GRE (VIBE used also for Inline subtraction as a pre-contrast mask image).



3 Dynamic liver MRI (T1-weighted 3D VIBE) shows multiple liver lesions with pathognomonic enhancement patterns of rectal carcinoma metastases: **3A** arterial phase, **3B** and **3C** portal-venous phase, **3D** equilibrium phase

In this case, the delayed post-contrast images were obtained at 40 minutes after contrast injection. Delayed images show parenchymal enhancement due to hepatocyte uptake of gadoxetate, but no enhancement of non-hepatocytic lesions such as metastases. Enhancement of the bile, due to hepatocyte excretion of the contrast agent will also be apparent.
Six lesions with the MRI characteristics of liver metastases were identified, lying superiorly near the margin between segments 7 and 8 (Fig. 4B), more centrally in segment 7 (Fig. 4A), in segment 6 (three lesions – Fig. 4D), and in segment 3 (Fig. 4C).
A small hypointense lesion in segment 8 (Fig. 5) shows no arterial phase enhancement, and is thought incidental (it was not identified in the thicker-section T2-weighted images).
Note was also made of the presence of several small, rounded masses in the right lung (e.g. Fig. 4A), indicating the presence of lung metastases as well as liver metastases. This, and the presence of liver lesions in both right and left lobes, argued against resection of the liver lesions with curative intent.

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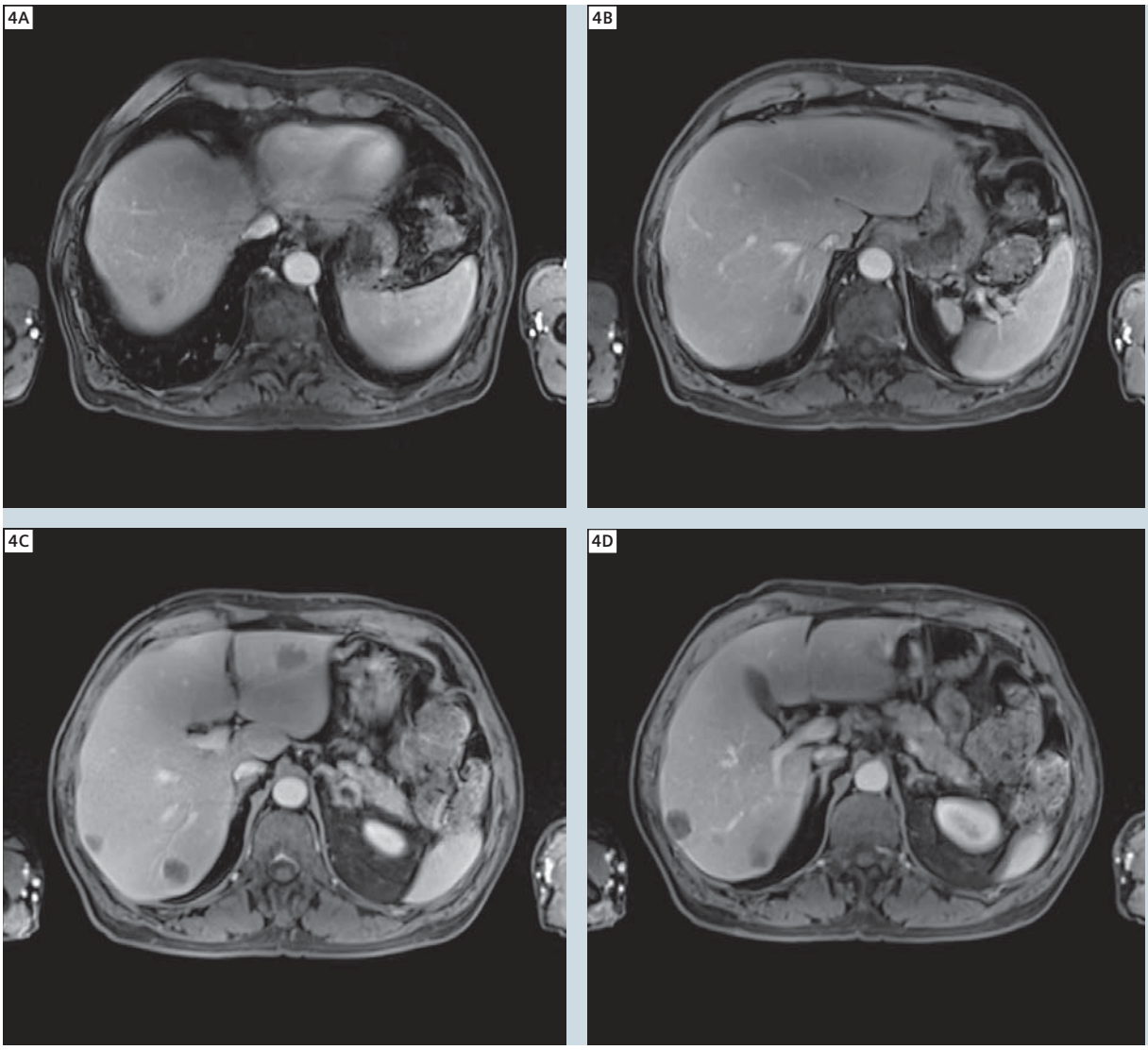
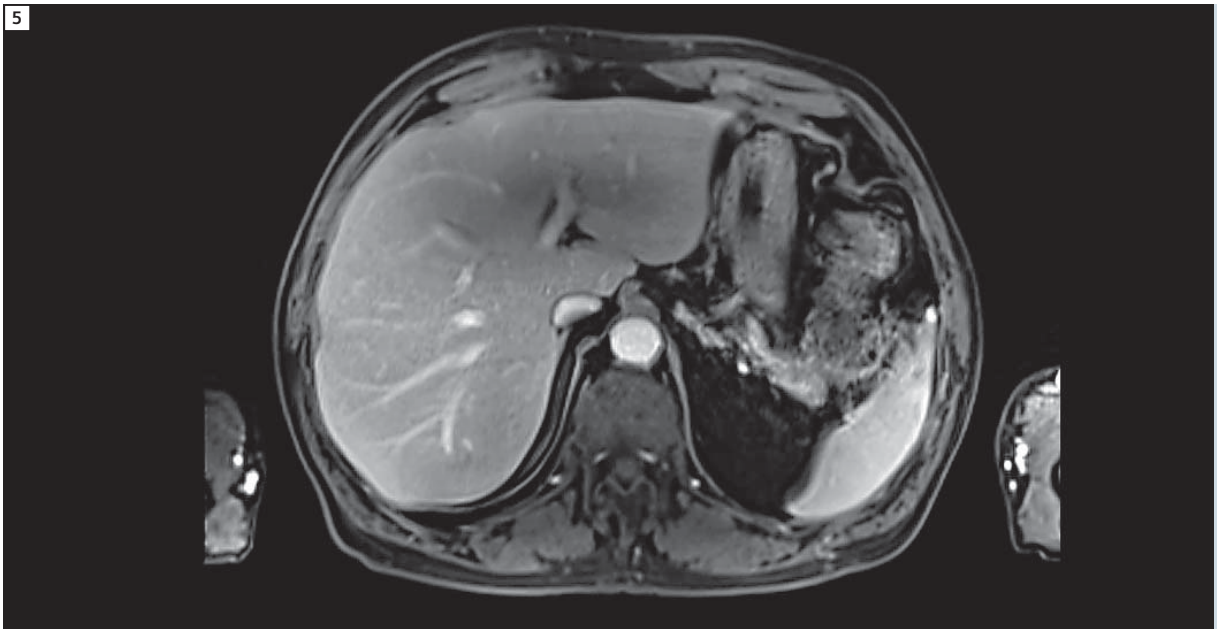


4 Dynamic liver MRI (T1-weighted 3D VIBE) demonstrates a multifocal spread of the rectal cancer within both lobes of the liver (sorted in craniocaudal slice orientation).



5 Hypointense lesion in segment 8 without correlation on T2-weighted MRI.