



# The Utility of MR for Whole Body Imaging

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## Introduction

Recent clinical results underline the usefulness of whole body MRI as an accurate alternative to conventional multi-modality evaluation. A whole body protocol using T1 and STIR weighted sequences has already shown its superiority versus conventional modalities like bone scintigraphy. Adding a diffusion-weighted imaging (DWI) acquisition allows a comprehensive exam in less than 40 minutes and drives MRI towards new horizons.

## Technique

Laveran Military Hospital uses three sequences to image the whole-body with a GE Healthcare Signa® HD 1.5T 8-channel platform: coronal T1 fast spin echo (FSE), coronal STIR and axial DWI EPI.

The scan parameters are:

- 1) FSE T1: TR/TE 385/10 ms, ETL 2, BW 50 kHz, 8 mm slice thickness with 1 mm gaps, matrix of 320 x 160, field-of-view (FOV) 44 cm<sup>2</sup>
- 2) STIR: TR/TE 8400/30 ms, T1 145 ms, ETL 20, BW 62.5 kHz, 8 mm slices with 1 mm gaps, matrix of 320 x 224, FOV 44 cm<sup>2</sup>
- 3) DWI EPI: TR/TE of 7100 /85 ms, matrix of 80 x 128, FOV 36 cm<sup>2</sup>, b=600 s/mm<sup>2</sup>

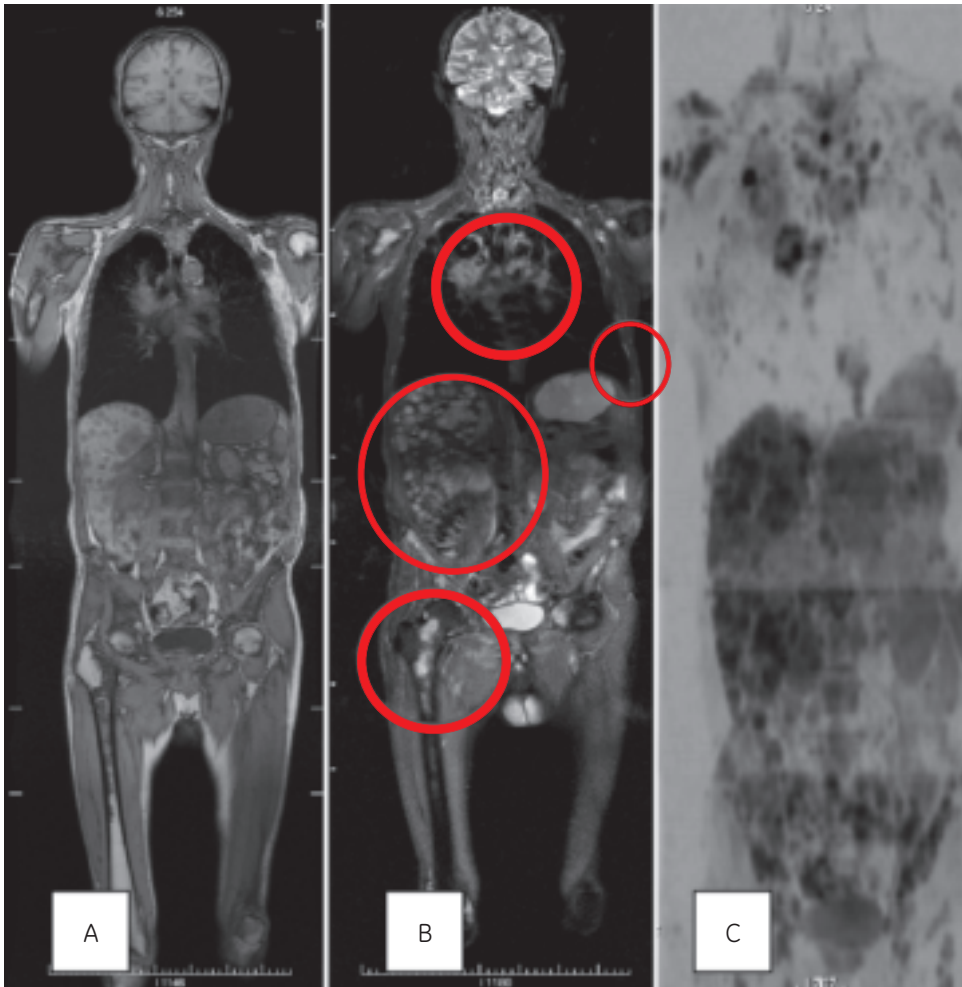
To image the body in total, a four or five station protocol (depending on patient size) is acquired with an overlap between stations. An integrated body coil is used except at the thoracic-abdominal level where the 8-channel body array coil is utilized to realize breath-hold acquisition with parallel imaging techniques.

## Visualization

All T1 acquisitions are pasted together and allow analysis from head to toes (same procedure for STIR images). To review DWI images, an inverse grayscale intensity scale is applied on 20 mm coronal MIP to obtain a "PET-like" image. This static coronal projection allows direct comparison with other modalities, such as a bone scan.

### Case 1

Patient is a 54-year-old male with small cell neuroendocrine carcinoma (tumor stage T2N2) of the right superior lobe of the lung.



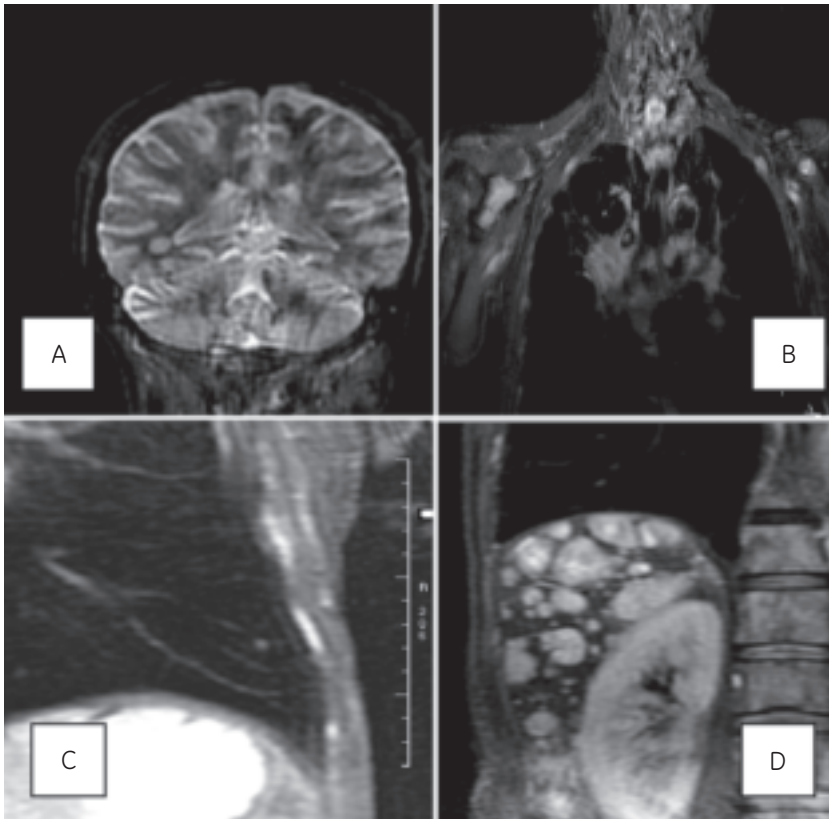
(A) Coronal T1 acquisition using out of phase TE  
(B) Coronal STIR acquisition  
(C) Axial DWI acquisition

Trevor La Folie, M.D., is the lead for MRI Oncology imaging in the radiology department under the direction of Professor J.F. Briant.

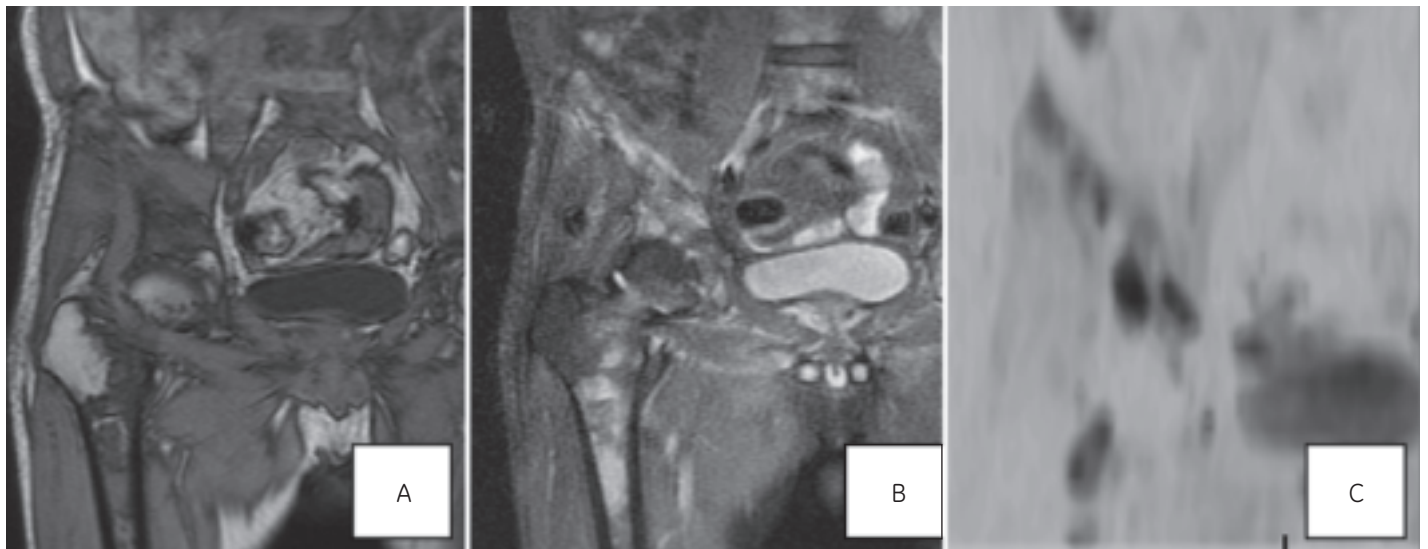
#### About the Laveran Hospital Marseille, France

The Laveran Hospital is a military institution of 316 beds built in 1963. It bears the name of the army medical officer Charles Louis Alphonse Laveran, who discovered the parasite of paludism in 1880 in Algeria. The hospital is a multi-specialty facility, although it traditionally specialized in Tropical Medicine. The MR system was initially installed by GE in 2001 as a Signa 1.5T MR and was recently upgraded to the Signa HDx platform.

Case 1 (continued)



(A) STIR: 9 mm secondary lesions in the right temporal lobe  
(B) STIR: Hilar primary tumor with hilar and mediastinal lymph nodes  
(C) Metastatic micro-nodule of 4 mm located in the left lateral-basal segment  
(D) Hepatomegaly with multiple hepatic metastases

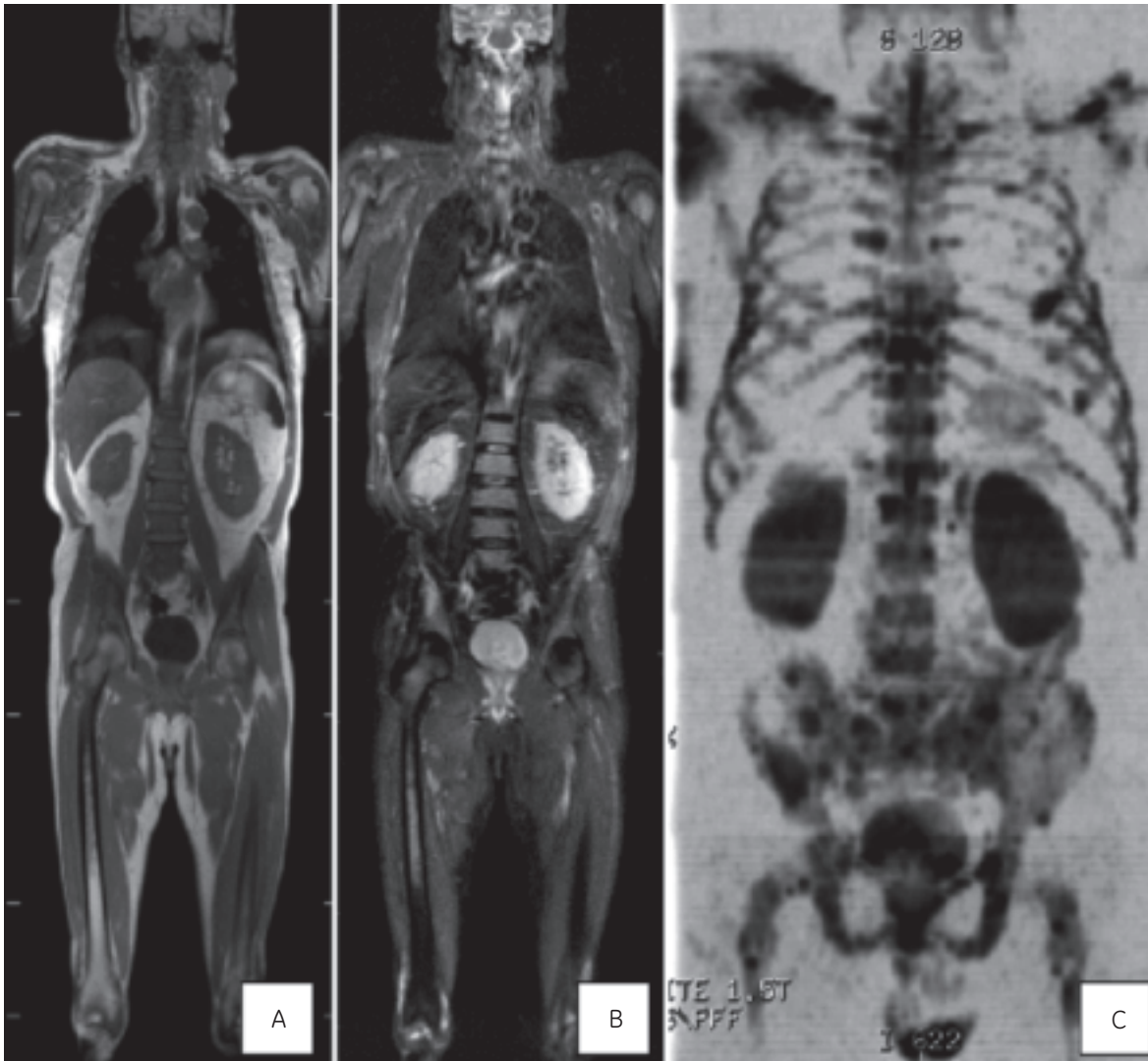


Femoral and iliac bone metastases

- (A) T1 hyposignal
- (B) STIR: hypersignal
- (C) DWI: hypersignal

## Case 2

Patient is a 69-year-old male with Stage III multiple myeloma.



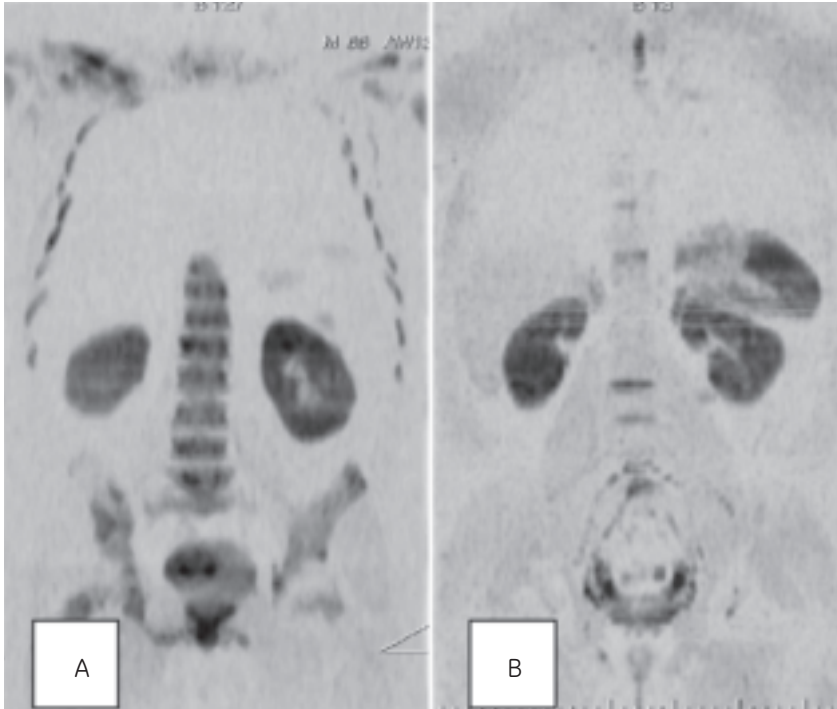
(A) Coronal T1

(B) Coronal STIR

(C) MIP coronal projection of an axial DWI acquisition

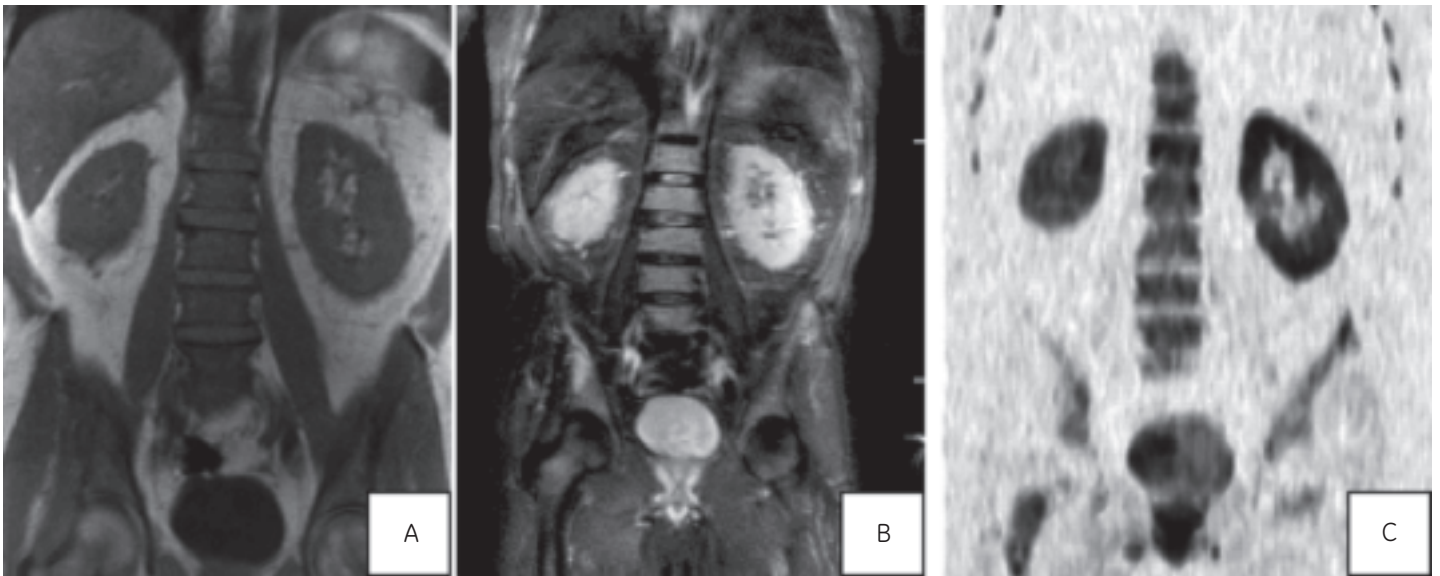
...MRI findings impacted the therapeutic strategy as N-staging was reclassified as a Stage III and not II as originally reported based on PET/CT scans.

Case 2 (continued)



DWI acquisition using a b-value of 600 s/mm<sup>2</sup>

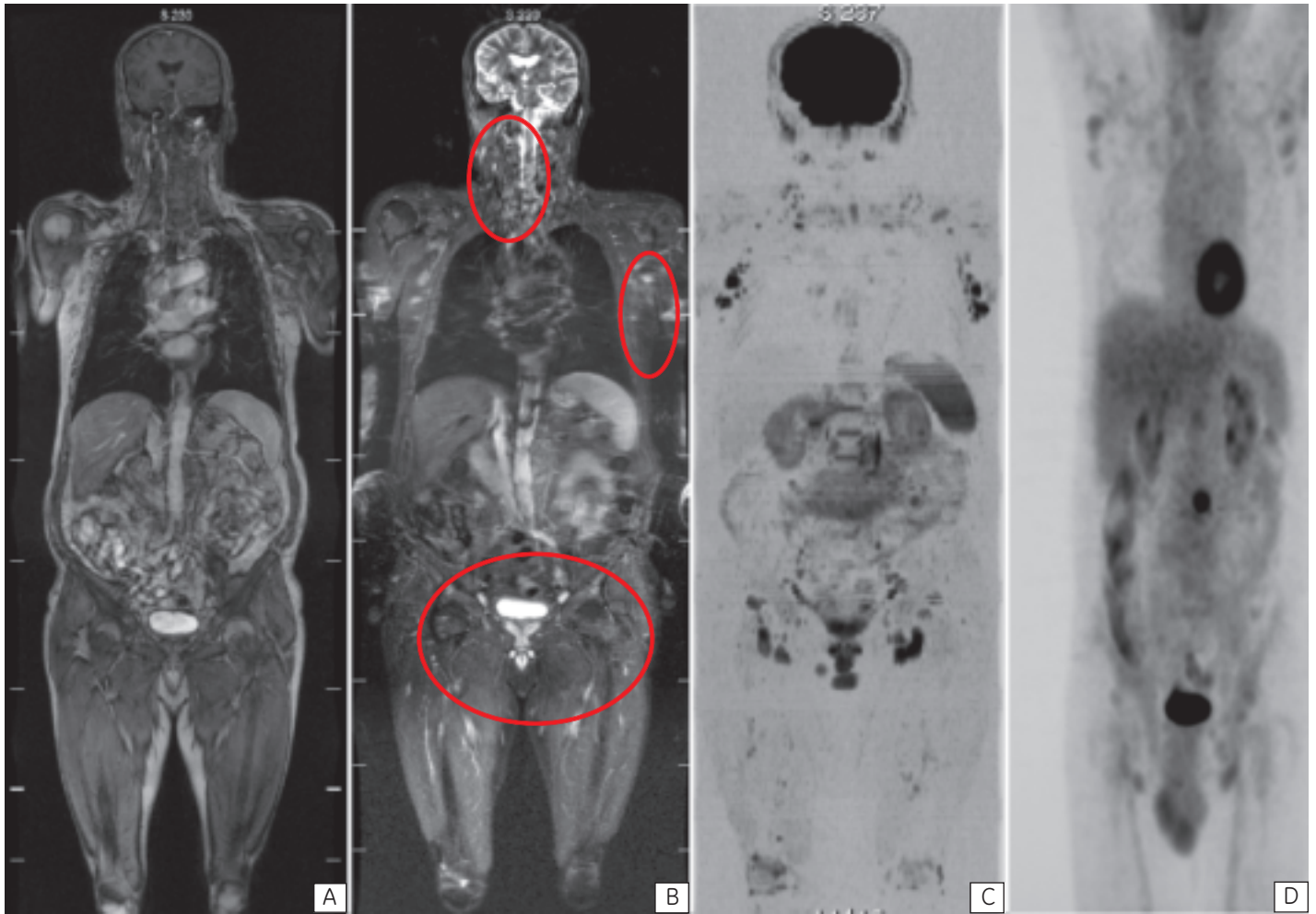
- (A) Diffuse tumoral bone marrow infiltration with hyper-signal intensities in the axial skeleton, pelvis, the ribs and femoral heads.
- (B) Normal subject with normal appearance (iso-signal intensity) of the axial skeleton and hyper-signal intensity of the vertebral discs and organs with large water components.



- (A) Hypo-signal intensity in T1 imaging
- (B) Hyper-signal intensity in STIR
- (C) DWI acquisition of the vertebral bodies due to tumoral bone marrow infiltration

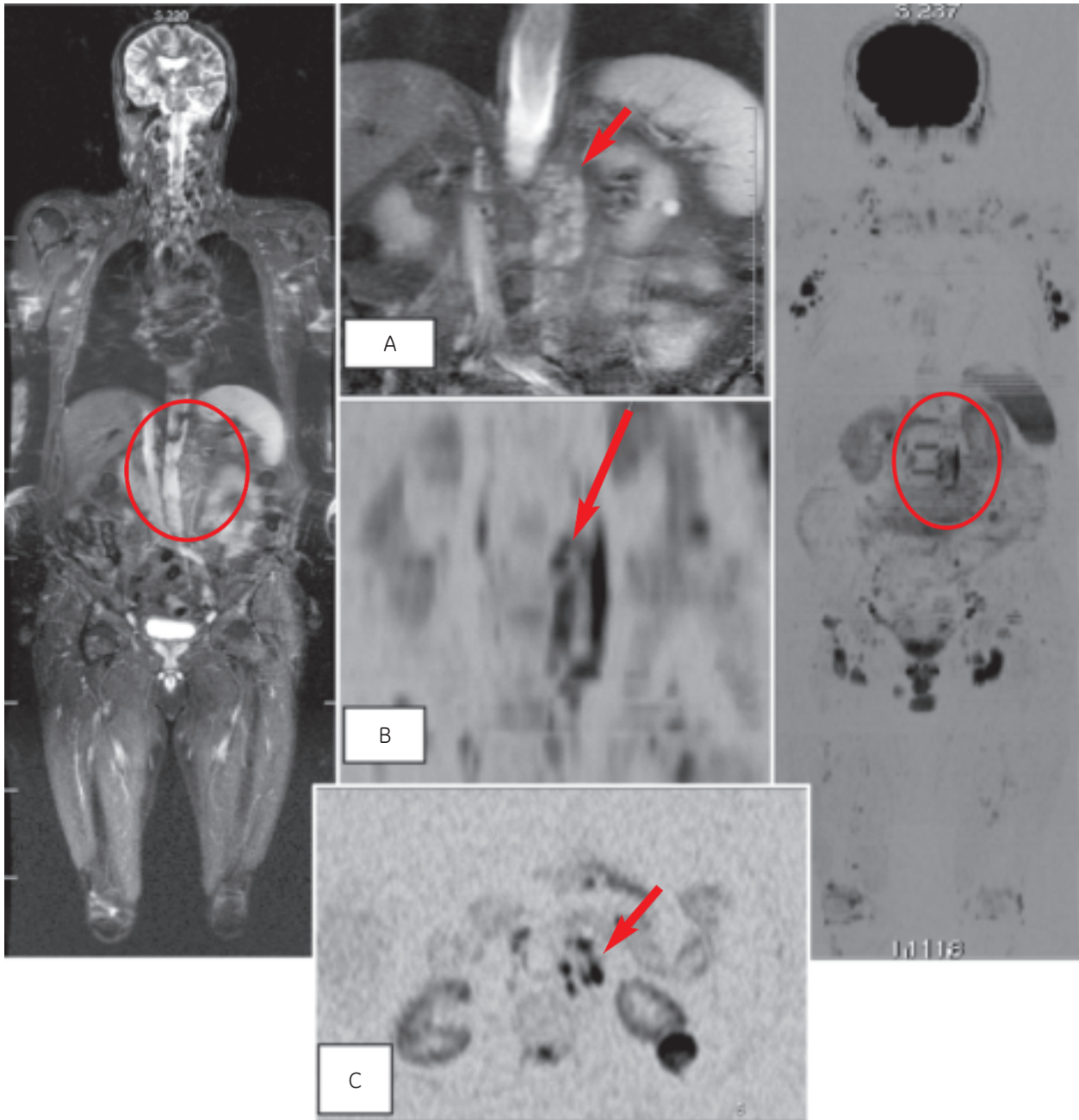
### Case 3

Patient is a 61-year-old male with Non-Hodgkin's mantle cell lymphoma, assessed Stage II by PET/CT.

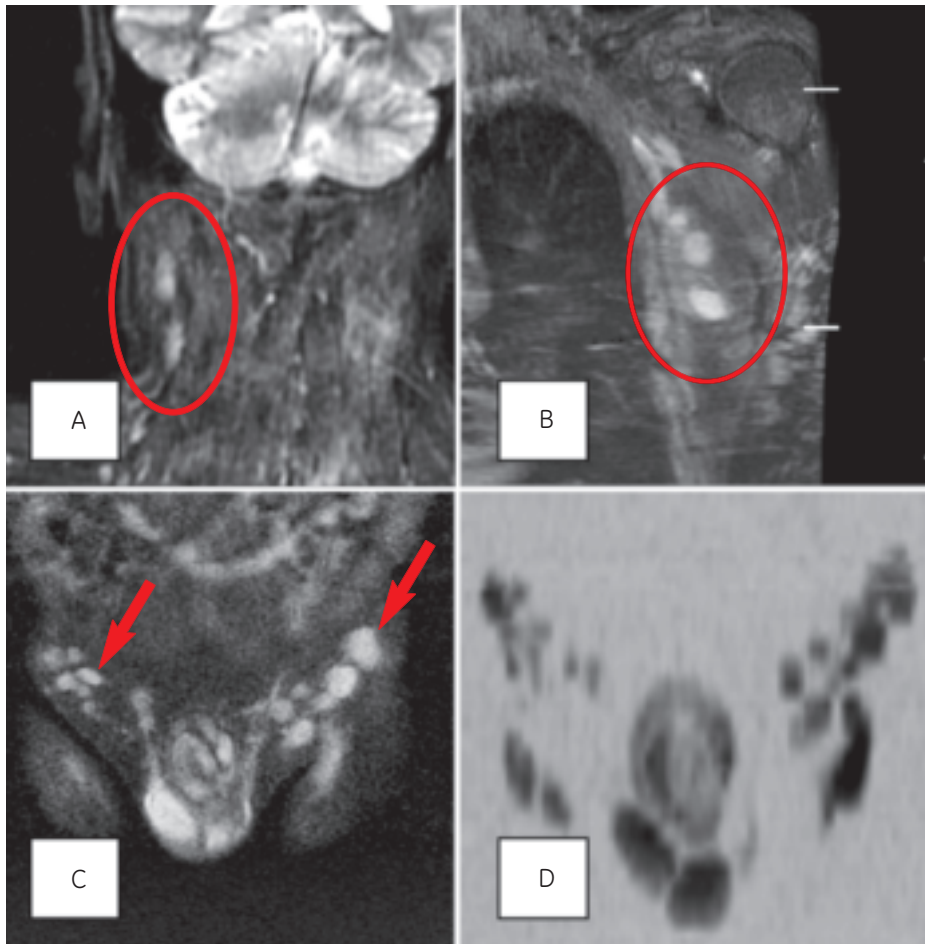


(A) Coronal 3D LAVA acquisition after gadolinium administration  
(B) Coronal STIR acquisition  
(C) Axial DWI acquisition  
(D) PET/CT

Case 3 (continued)



- (A) STIR
- (B) DWI: Suspicious signal intensity of retroperitoneal lymph nodes of normal size
- (C) DWI: The axial view (native acquisition plan) avoids partial volume and allows the right location of the lesions using kidneys, vertebral bodies and aorta as anatomical references. Lymph nodes are clearly identified as para-aortic lesions.

**Case 3** (continued)

DWI acquisition using a b-value of 600 s/mm<sup>2</sup>

- (A) STIR: Hyper-signal intensities demonstrating right cervical (jugular) lymph nodes
- (B) STIR: Left axillary lymph nodes
- (C) STIR
- (D) DWI: Bilateral inguinal lymph nodes of variable size in hyper-signal

**Discussion**

MRI found more suspicious lymph nodes (retroperitoneal and inguinal) compared to PET/CT. The malignancy of the entire left inguinal lymph group (missed by PET/CT) was confirmed by biopsy.

In this examination, MRI findings impacted the therapeutic strategy as N-staging was reclassified as a Stage III and not II as originally reported based on PET/CT scans.

**Conclusion**

Despite these findings, DWI should still be considered an emerging technique for this type of examination and will require further validation. The team at The Military Hospital of Laveran systematically include a DWI acquisition for all protocols in a patient's cancer examination. ■