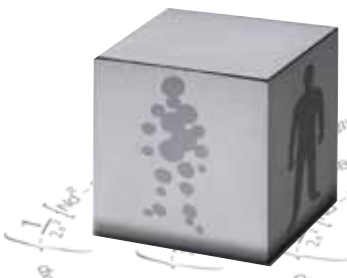
Case Report

Prostate MRI

MRI-targeted TRUS-guided biopsy



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Patient history

Sixty-four y/o man presenting with a raising PSA level. The more recent value is 7ng/ml. Digital rectal examination is non-suspicious and prostate volume is estimated at 30ml. A multiparametric MRI is performed prior to TRUS-guided biopsies. The MRI protocol includes three sequences : one T2 weighted sequence (T2W), one diffusion weighted sequence (DW) and one dynamic contrast enhanced sequence (DCE). The T2 weighted sequence is a 3D acquisition with a voxel size of 0.35cc (0.7 x 0.7 x 0.7mm). The DW sequence is acquired with several b-values (b100-200-400-1000) from which is extracted the Apparent Diffusion Coefficient value. The DCE sequence is a gradient echo sequence after IV bolus injection (0.1mmol/kg) of a chelate of gadolinium (Gadovist, Bayer). Several phases are acquired with a temporal resolution of 8.5s for a total acquisition time of 5 mn (35 phases).

Post-processing is performed on a dedicated workstation (Olea Sphere™ , Olea Medical®, La Ciotat, France) which allows for the measurement of dynamic quantitative parameters, extracted from the Tofts model (1). Ktrans or transfer constant corresponds to the wash-in. Kep is the rate constant and corresponds to the wash-out. The area under the concentration of gadolinium 60s after the beginning of contrast injection (AUGC), corresponding to the maximum peak enhancement, is also calculated. Absolute values of the three parameters are color-coded and displayed on screen.
Mp-MRI (Fig. 1) shows two suspicious areas within the peripheral zone corresponding to two significant tumors diagnosed by MRI-targeted TRUS-guided biopsies (Fig.2) with TRUS-MRI image fusion (Koelis system, Grenoble, France) and confirmed at pathological examination of the radical prostatectomy specimen (Fig. 3).

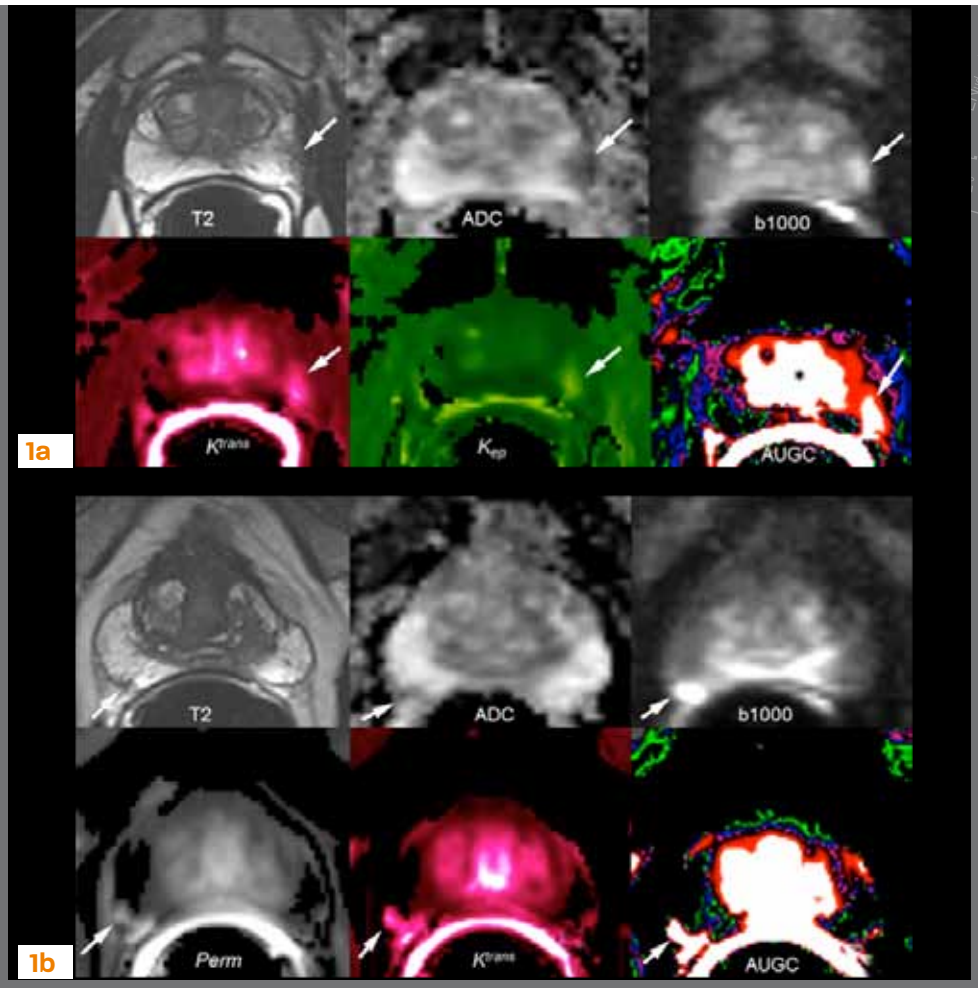

Figure 1a & 1b: multiparametric MRI.

1a: One lesion is visible in the left apex (arrow). It has a discrete low signal intensity on the T2 image, but impeded diffusion is clearly visible, showing a focal low signal on the ADC map and a high intensity area on the long b-value (B1000). DCE-MRI shows a bright area corresponding to high values of Ktrans, Kep and AUGC. Note the physiological hypervascularity of the TZ (*).

1b: At the right prostate base, a second lesion is present (arrow), barely visible on T2W-MRI and on the ADC map, but highly conspicuous on trace diffusion images. DCE-MRI shows an increased permeability of tumor vessels on source DCE images (white arrow, perm), on the right postero-lateral aspect of the prostate, but color coded images of quantitative parameters (Ktrans and AUGC) extracted from the post-processing of the dedicated workstation (OleaSphereTM) make the diagnosis obvious.

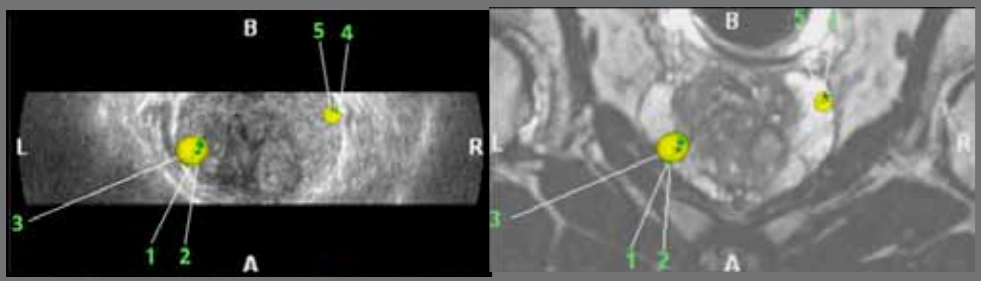

Figure 2: MRI targeted TRUS guided biopsies using the Koelis system which allows for a TRUS-MRI image registration after deformation of the MRI prostate shape to accurately adjust it to the TRUS prostate shape. A region of interest (ROI, yellow tag) has been placed on the MRI targets. Once image fusion has been performed, the ROI's can be displayed indifferently on the MRI or the TRUS image, allowing for an accurate targeting of the lesion on the basis of the MRI findings. Three biopsies have been performed in the apical lesion (1-3, green tags) and two in the lesion of the left base (4-5). Bilateral Gleason score 7 (3+4) cancer. L: left side. R: right side

Courtesy of François Cornud, MD
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Discussion.

The ability of multiparametric MRI to localise tumor foci of prostate cancer is now established (2). DW-and DCE-MRI have increased the performance of T2W-MRI (3), which lacks specificity. DW-MRI shows the impeded diffusion of areas with high cellular density, which characterizes tumor foci of prostate cancer, especially when they contain high Gleason grades (4). DCE-MRI with dedicated workstations, like the OleaSphereTM system, enables a fast and accurate reading of the different quantitative (Ktrans, Kep, ve, vp) parameters (1) depending on the type of pharmacokinetic model used. Color coded maps make tumor foci highly conspicuous and this capacity can also be used to assess kinetics of Gadolinium with semi-quantitative parameters, like wash-in, wash-out, time to peak or maximum peak enhancement (5). These parameters can be assessed visually (6, 7) on the source images thanks to the different color coded maps of semi-quantitative parameters available on the OleaSphereTM workstation (8). These color coded images can be combined with placement of regions of interest (ROI's) to obtain different types of curve of enhancement (9).

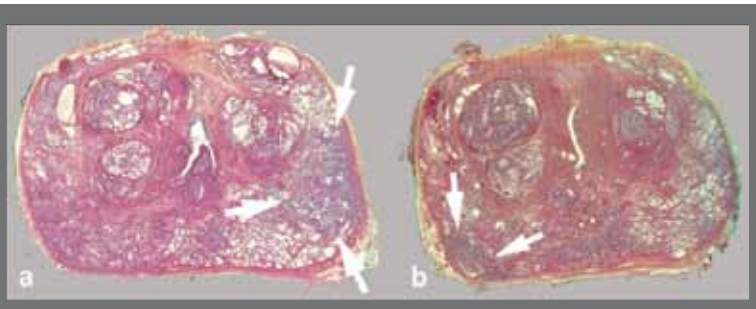

Figure 4 : Pathological examination of the radical prostatectomy specimen. The main (index) lesion (1.6cc) is on the left side (arrows, a), at the apex. The contralateral tumor, located in the prostate base, has a significant volume (0.8cc). Bilateral Gleason score 7 lesion with 40% grade.

Our case illustrates how mp-MRI can identify men with potentially clinical bilateral significant PCa prior to biopsy. It also shows that, once a target has been identified on MRI, the physician must have this information available at the time of biopsy to match as accurately as possible the needle tract and the target, hence the concept of TRUS–MRI image registration (or image fusion) to plan and to guide the biopsy. An accurate TRUS-MRI fusion system has to take into account the difference in prostate shape between TRUS and MRI and also consider patient and prostate motion during TRUS examination. The Koelis system (Koelis Inc., La Tronche, France) has this capability and allows, as illustrated in our case, for a precise MRI-targeting of focal abnormalities during TRUS guided biopsies (10).

In conclusion, our case suggests that the use of MRI in prostate cancer management is very promising, not only in patients with a diagnosed PCa, but also for men before prostate biopsy. Standardization of criteria which define a target is mandatory. Different scoring systems are currently used (3, 9, 11, 12). All include an individual three or five-point scale T2/DW/DCE score and an overall five point scale Likert score with a trend to take into account the dominant sequence according to the zone of origin of the lesion (DWI-MRI for the PZ and T2W-MRI for the TZ). Because the degree of suspicion on MRI is a powerful predictor of significant cancer (13-16), a standardized report is crucially required to define what is benign or probably benign (score 1-2), equivocal (score 3) and probably malignant or malignant (score 4-5).

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