

Study Investigates the Role of Multiparametric MR Imaging for the Detection of Transition Zone Prostate Cancer



Studies have found that the prostate's transition zone (the tissue between the prostatic urethra and the peripheral zone) harbors cancer in up to 25% of patients who undergo radical prostatectomies.¹ However, detecting these cancers with any degree of confidence through diagnostic imaging techniques alone is precluded due to nodules from fibromuscular (stromal) benign prostatic hyperplasia typically found in the transition zone.

T2-weighted (T2w) imaging, while significantly limited as a tool for depicting transition zone cancers,² is useful in detecting homogenous elliptical, low signal intensity masses with ill-defined margins and no capsule, which are considered suspicious for transition zone cancer.³

While transition zone cancer is associated with an increase in choline and a reduction in or lack of citrate, the broad range of metabolite ratios in the transition zone make the use of a single ratio for MR spectroscopic indication of cancer in this area virtually impossible.⁴

Diffusion-weighted imaging (DWI) coupled with T2w imaging may improve the accuracy in detecting cancerous lesions in the transition zone; however, there is some controversy regarding this arrangement.^{2,5}

Some published reports indicate that dynamic contrast enhanced (DCE) MRI may have a greater sensitivity than T2w imaging alone for depicting transition zone cancers.^{6,7} Yet, there is also controversy about this claim, as other published reports indicate that this technique has limitations as well.²

Dr. Adilson Prando, chairman of the Department of Radiology and Diagnostic Imaging at Hospital Vera Cruz (Campinas, São Paulo, Brazil) and his team investigated the role of conventional T2w MR imaging, functional MR imaging and functional MR (spectroscopy, DWI, and DCE imaging) for their value in detecting transition zone prostate cancer in patients with elevated prostate-specific antigen (PSA) levels and negative biopsies.

Method

A total of 347 patients with elevated PSA and negative biopsies were prospectively submitted to a study in which they would undergo conventional and functional MRI studies.

With conventional MR imaging, findings that were considered suspicious included focal elliptical areas with homogenous low T2w signal intensity, poorly defined margins, and lack of a capsule.

In the functional MRI studies, findings that were deemed suspicious included:

- MR spectroscopic imaging (MRSI) depicting clusters of voxels with abnormal choline and creatine/citrate ratios (greater than four standard deviations);
- Diffusion weighted imaging: marked low signal intensity on ADC map; and,
- Dynamic contrast enhanced: focal area with fast wash-in/ fast wash-out.

Parameters used in the four MR techniques employed in this study are provided in the following tables:

T2w images		MR spectroscopic images	
TR/TE	3500/130	Data sets	16x8x8 phase encoded spectral arrays
NEX	3	Voxels	1024
Slice thickness	3 mm	Nominal spatial resolution	0.34 cm ³
Gap	0	Time	17 minutes
FOV	13		
Freq. x phase	256x224		
BW	20.83 kHz		
Diffusion weighted images		Dynamic contrast enhanced images	
PSD	SE/EPI	Protocol	M3D/Fast SPGR
NEX	4	Flip angle	15
Slice thickness	4 mm	Slice thickness	4 mm
TR/TE	4000/82.1	FOV	160x160 with zip 512
FOV	128x192	NEX	0.68
Coils	Endorectal 8-Channel body	Time	1 min, 52 sec
B value	1000	Coils	Endorectal 8-Channel body

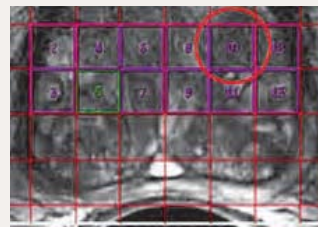
Results

Conventional and/or functional MRI findings suspicious for transition zone cancer were observed in 30 of the 347 patients (8.6%). Subsequent transrectal ultrasound (TRUS) guided biopsy directed by these findings confirmed a diagnosis of cancer in 13 of the 30 patients (43%) in whom MRI revealed suspicious findings.

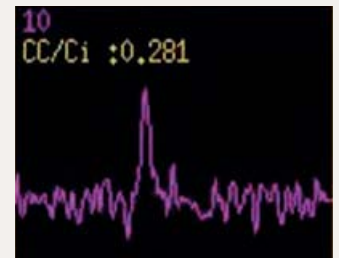
In eight of 30 patients with negative biopsies, histological examination revealed benign stromal prostatic hyperplasia. In this patient group, PSA levels ranged from 5.5 to 16 ng/ml.

Patient 1:

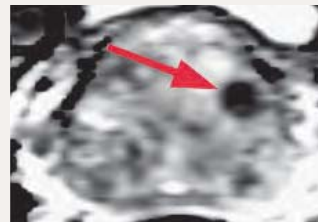
64-year-old with a PSA level of 11.2, three negative biopsies and cancer (Gleason score 6) in the left transition zone.



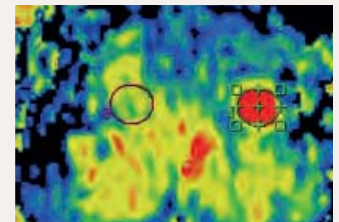
Spectroscopic imaging data overlaid on a T2w image. Voxel 10 shows a hypointense lesion in the left transition zone (red circle).



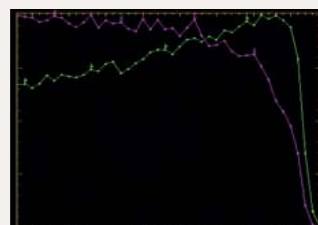
3D spectrum shows normal levels of choline and citrate.



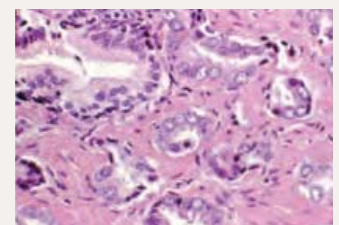
Focal area with marked DWI ADC map (arrow).



Fast wash-in, fast wash-out on DCE (green circle) compared with normal transition zone tissue (purple circle).



Time intensity curves corresponding to DCE image.



Histology slide from TRUS-guided biopsy confirmed cancer in the prostate transition zone.

Result

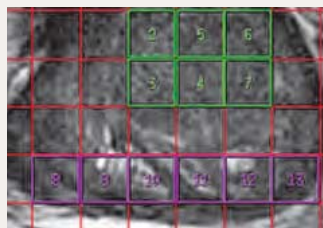
When T2w, DWI and DCE were positive, there was a sensitivity of 43% and specificity of 88%.

Patient 2:

A 66-year-old patient with cancer (Gleason score 7) in the left transition zone.



T2w image shows a large, homogenous hypointense area with ill-defined margins in the left transition zone (arrows).



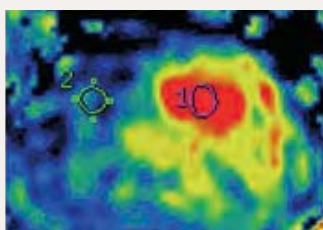
Spectroscopic imaging data overlaid on T2w image.



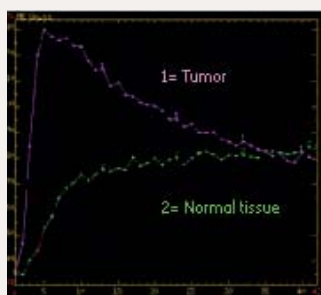
3D spectrum shows an elevated level of choline and a lack of citrate.



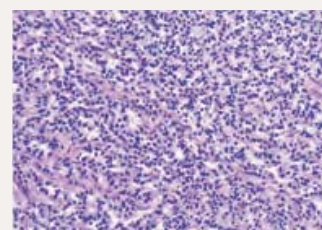
Marked low intensity on ADC map (DWI) (arrow).



Fast wash-in, fast wash-out on DCE (purple circle).



Time-intensity curves illustrate DCE fast wash-in, fast wash-out.



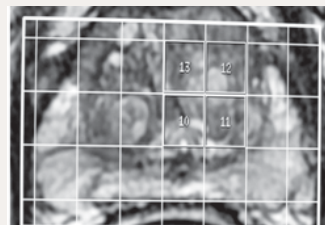
Histology slide of tissue obtained with TRUS-guided biopsy confirms cancer diagnosis.

Result

When all four techniques were positive for transition zone cancer, a sensitivity of 30% and a specificity of 100% were demonstrated.

Patient 3

A 69-year-old patient with PSA of 11.7, four negative biopsies and cancer (Gleason score 6) in the left transition zone.



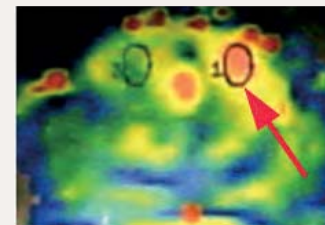
Spectroscopy data overlaid on a T2w image. The transition zone appears normal.



The 3D spectrum reveals an elevated level of choline and a lack of citrate.



DWI (ADC map) shows an area with marked low intensity in the left transition zone (arrow).



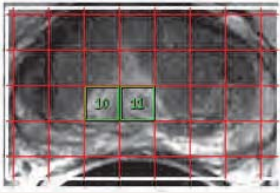
DCE showing fast wash-in, fast wash-out of the same area shown in the DWI.

Result

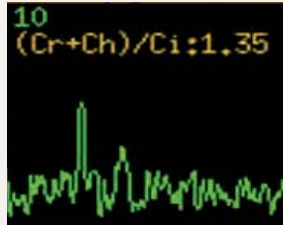
When MRSI, DWI and DCE were positive, sensitivity was 30%, specificity was 100%. Functional studies proved to be very important in diagnosing patients with normal-appearing transition zones on T2w images.

Patient 4

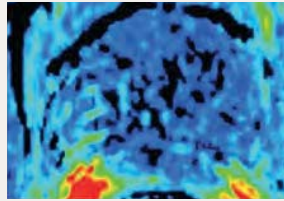
A 59-year-old patient with benign stromal hyperplasia.



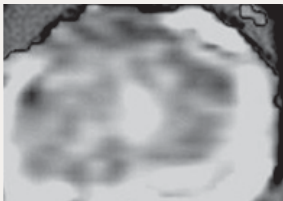
Spectroscopy data overlaid on a T2w image. The transition zone appears normal.



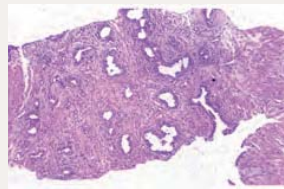
The 3D spectrum of voxel 10 reveals high level of choline and reduced citrate.



DCE shows no area of enhancement.



Normal aspect of the transition zone on DWI ADC map.



Histology of tissue sample obtained with TRUS-guided biopsy directed with spectroscopic findings in voxel 10 revealed benign stromal hyperplasia.

Result

When only spectroscopy was suspicious for cancer, sensitivity was 61% and specificity was 41%.

The table shows the sensitivity and specificity of the different MR imaging techniques in diagnosing transition zone cancer in patients with elevated PSA and negative biopsies.

Isolated positive techniques	T2w	DWI	DCE	MRSI
Sensitivity	61%	61%	69%	61%
Specificity	64%	58%	52%	41%

Conclusions

While detection of prostate transition zone cancer is difficult, imaging plays a significant role in identifying suspicious areas for further analysis.

In patients with negative biopsies and elevated PSA levels, conventional T2w imaging was the best isolated technique for detecting transition zone cancer, with a sensitivity of 61% and specificity of 64%. However, when T2w imaging was negative and DWI, MRSI, and DCE were positive, sensitivity was 30% and specificity was 100%. In this group of patients, the combination of findings seen with T2w imaging and DWI ADC map yields a sensitivity of 53% and a specificity of 88%.

When all four techniques were positive, sensitivity was 30% and specificity was 100%. ■

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About the facility

Hospital Vera Cruz was founded by a group of physicians in 1943 and is considered one of the best private hospitals in the region of Campinas, São Paulo, Brazil. The hospital continues to grow rapidly by performing procedures in all medical specialties. The hospital's department of radiology, Centro Radiológico Campinas, performs around 13,000 radiological studies per month, including interventional radiological techniques.

References

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