# Utility of Quantitative T2 Signal Intensity and ADC Measurements in Differentiating Prostate Cancer from Post-Biopsy Hemorrhage

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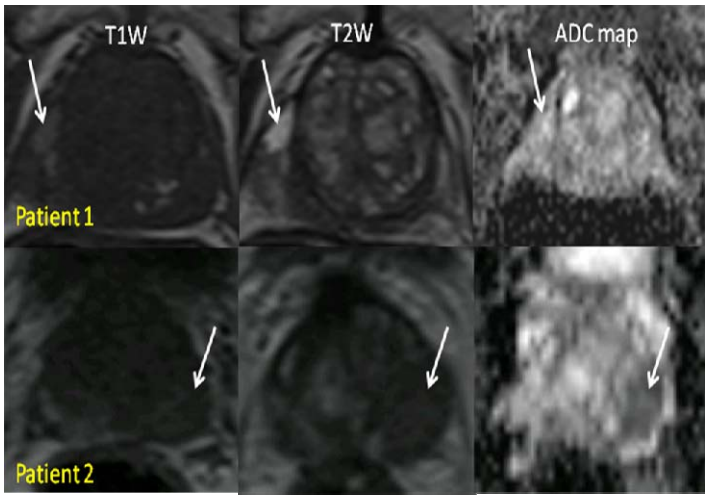
**Introduction:** Our objective was to assess the role of T2WI and DWI for differentiating post-biopsy hemorrhage from tumor in prostate cancer (PCa) patients, and investigate the relationship between hemorrhage and presence of peripheral zone (PZ) tumor.

**Methods:** 13 preliminary patients with PCa (from an ongoing study) underwent MRI on a 1.5T Siemens Avanto scanner, including axial T1WI, T2WI and DWI (b = 0-500-1000 sec/mm$^2$) before prostatectomy. Two observers in consensus identified areas of hemorrhage and tumors based on prostatectomy data. For each case, one representative PZ focus that was free of both hemorrhage and tumor was selected for ROI placement to measure T2 SI (signal intensity) and ADC (apparent diffusion coefficient). Similar measurements were recorded for all foci of hemorrhage without corresponding tumor. For all tumor foci that were visible on T2WI and DWI, respective T2 SI and ADC values, as well as the presence of hemorrhage within the exact tumor focus were recorded. Muscle T2 SI was recorded for each case to allow calculation of rT2 [ratio of (PZ-T2 SI)/(muscle-T2 SI)][1,2]. The frequency of hemorrhage within tumor foci was calculated. In addition, rT2 and ADC of benign non-hemorrhagic, benign hemorrhagic, non-hemorrhagic tumor, and hemorrhage-containing tumor foci were compared.

**Results:** Of 31 tumor foci recorded by the pathologist in the 13 patients, only 1 focus (3%) contained hemorrhage. rT2 and ADC were recorded for a single benign non-hemorrhagic focus in each patient and for a total of 5 benign hemorrhagic foci. rT2 and ADC were respectively recorded for 22 non-hemorrhagic tumor foci visible on T2WI and 19 such foci visible on ADC. rT2 and ADC were significantly lower for non-hemorrhagic tumor foci than for both hemorrhagic and non-hemorrhagic benign foci; there was no significant difference in rT2 and ADC between hemorrhagic and non-hemorrhagic benign foci (Table). Statistical analysis was not performed for the single hemorrhagic tumor focus identified.

**Discussion**: Our preliminary data supports the use of quantitative T2 SI ratio and ADC values to differentiate tumor foci from benign hemorrhage, generally viewed as mimics of each other. Our observed low prevalence of hemorrhage within tumor foci is preliminary, and has been shown by a recent study[3]. The identification of more hemorrhagic tumor foci will help elucidate the relationship between these two processes. Data from additional patients may confirm the role of quantitative T2 SI and ADC measurements in differentiating tumor and benign hemorrhage.




**Patient 1:** Right midgland hemorrhagic focus (arrow) shows high T1 signal, high T2 signal, and iso-to-high ADC (2.0 x 10$^{-3}$ mm$^2$/sec). Decreased T2 signal that may be expected from hemorrhage was not noted.
**Patient 2:** Left base non-hemorrhagic tumor focus shows low T1 signal, low T2 signal, and low ADC (0.79 x 10$^{-3}$ mm$^2$/sec).

| | Benign non hemorrhagic PZ | Benign hemorrhagic PZ | Tumor |
|---|---|---|---|
| **rT2** | 9.3 ± 2.8 | 8.0 ± 3.4 | 4.8 ± 1.3* |
| **ADC**** | 1.7 ± 0.2 | 1.5 ± 0.5 | 1.1 ± 0.3* |

*Significant differences in rT2 and ADC (p=0.001-0.02) between tumor and both non-hemorrhagic and hemorrhagic normal PZ ** ADC x 10$^{-3}$ mm$^2$/sec

**References:**
1. Wang LW, et al. Radiology 2008;246:168-176.
2. Engelhard K, et al. Eur Radiol 2000;10:1947-53.
3. Tamada T et al, Radiology 2008;248:531-539.