IMAGING

Correlation of proton MR spectroscopic imaging with Gleason score based on step-section pathologic analysis after radical prostatectomy

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Purpose: To determine whether hydrogen 1 magnetic resonance (MR) spectroscopic imaging can be used to predict aggressiveness of prostate cancer.

Materials and Methods: All patients gave informed consent according to an institutionally approved research protocol. A total of 123 patients (median age, 58 years; age range, 40-74 years) who underwent endorectal MR imaging and MR spectroscopic imaging between January 2000 and December 2002 were included. MR imaging and spectroscopy were performed by using combined pelvic phased-array and endorectal probe. Water and lipids were suppressed, and phase-encoded data were acquired with 6.2-mm resolution. Voxels in the peripheral zone were considered suspicious for cancer if $(\text{Cho} + \text{Cr})/\text{Cit}$ was at least two standard deviations above the normal level, where Cho represents choline-containing compounds, Cr represents creatine and phosphocreatine, and Cit represents citrate. Correlation between metabolite ratio and four Gleason score groups identified at step-section pathologic evaluation (3 + 3, 3 + 4, 4 + 3, and $\geq 4 + 4$) was assessed with generalized estimating equations.

Results: Data from 94 patients were included. Pathologic evaluation was used to identify 239 lesions. Overall sensitivity of MR spectroscopic imaging was 56% for tumor detection, increasing from 44% in lesions with Gleason score of 3 + 3 to 89% in lesions with Gleason score greater than or equal to 4 + 4. There was a trend toward increasing $(\text{Cho} + \text{Cr})/\text{Cit}$ with increasing Gleason score in lesions identified correctly with MR spectroscopic imaging. Tumor volume assessed with MR spectroscopic imaging increased with increasing Gleason score.

Conclusion: MR spectroscopic imaging measurement of prostate tumor $(\text{Cho} + \text{Cr})/\text{Cit}$ and tumor volume correlate with pathologic Gleason score. There is overlap between MR spectroscopic imaging parameters at various Gleason score levels, which may reflect methodologic and physiologic variations. MR spectroscopic imaging has potential in noninvasive assessment of prostate cancer aggressiveness.

Editorial Comment

MR spectroscopic imaging of prostate provides metabolic data to the anatomical data obtained with conventional MR imaging. This technique has demonstrated an improvement in localizing cancer to a sextant of the prostate, estimating extracapsular extension, assessing the aggressiveness of prostate cancer and in localizing hidden suspicious areas of cancer in patients with rising PSA and negative prior biopsies. Specifically, MR spectra from regions of prostate cancer show a significant reduction or absence of citrate and polyamines, while choline is elevated relative to creatine resulting in significant changes in the $(\text{choline} + \text{creatine})/\text{citrate}$ ratio in regions of cancer. In this paper, the authors confirm previous study on the value of MR spectroscopic imaging as a noninvasive tool to assess prostate cancer aggressiveness. This is a very important contribution since prostate cancer aggressiveness is a key predictor of patient outcome. Several studies have shown that the biopsy results are limited in the determination of all cancer and Gleason grades. In the present study the authors' shows that when compared with radical prostatectomy results, biopsy was used to correctly predict the pathologic Gleason score in only 64% of patients, 27 % were upgraded and 9 % downgraded. Another interesting observation was that the tumor volume, as defined by the number of MR spectroscopic imaging positive voxels, was positively correlated with Gleason score. In other words, MR spectroscopic imaging measurements of prostate tumor $(\text{Cho} + \text{Cr}) / \text{Cit}$ and tumor volume correlate with pathologic Gleason score.

In this study, they had a sub-optimal overall sensitivity of MR spectroscopic imaging for cancer Gleason 3+3. This results are very different from ours. We had a much higher sensitivity than 44% for the detection of tumor Gleason 3+3. One possible explanation is probably related to the fact that the authors used air in the endorectal coil. By switching the air to liquid perfluorocarbon, in the last 2 years, we were able to obtain much better MR spectra with superior metabolites discrimination and superior detection of tumor Gleason 3+3. Similarly to the authors we have found higher (Cho+Cr) / Cit ratios in patients with tumor with higher Gleason scores.

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Evaluation of the renal venous system on late arterial and venous phase images with MDCT angiography in potential living laparoscopic renal donors

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Objective: The objective of our study was to assess whether both renal arteries and renal veins can be evaluated using single-phase MDCT data sets alone to eliminate the need for both arterial and venous phase data sets.

Materials and Methods: One hundred consecutive potential living renal donors who underwent 4-MDCT were evaluated. CT was performed with 120 mL of IV contrast material at an injection rate of 3 mL/sec. Both late arterial and venous phase acquisitions were obtained at 25 and 55 sec from the start of IV contrast injection, respectively. The number of the right and left renal veins and its anatomic variations were assessed by two reviewers. Late arterial phase images were evaluated initially, and then venous phase images were analyzed to assess opacification of the renal vein and to see whether venous phase data sets changed or added information about the venous anatomy as seen on late arterial phase images.

Results: The retroaortic left renal vein was found in two subjects, and the circumaortic left renal vein was detected in three subjects. The renal veins were adequately opacified on late arterial phase images in all subjects. There were six subjects who had a normal left renal vein with a small posterior branch coursing posterior to the aorta and draining into the inferior vena cava, which were difficult to differentiate from the lumbar vein or ascending lumbar vein; in three of these six subjects, the small posterior branch was opacified only on venous phase images.

Conclusion: Late arterial phase images obtained at 25 sec after the start of contrast injection can reveal the renal vein anatomy except for a small posterior branch of the left renal vein difficult to differentiate from the lumbar or ascending lumbar vein, as seen in three subjects. The data suggest that venous phase imaging is not necessary for the evaluation of renal vein anatomy.

Editorial Comment

Recently, several studies have shown that helical multidetector CT angiography has the potential to replace excretory urography and renal angiography in the evaluation of potential living renal donors. As we know this evaluation should include the assessment of renal arteries, renal parenchyma, collecting system and renal venous system. In order to obtain such complete evaluation several acquisitions should be used (pre-contrast and 25 sec, 70-80 sec, and 180 sec after the start of an intravenous injection of contrast material). It is evident that the radiation dose delivered to living donor will increase with the number of acquisition performed. The purpose of this paper was to assess whether both renal arteries and renal veins can be evaluated using single-phase helical multidetector CT angiography in an attempt to eliminate the need for both arterial and venous phases. The authors concluded the late arterial phase images obtained at 25 sec adequately demonstrated renal arteries and the right and left renal veins in all subjects, but in 7% and 16% of the patients they could not demonstrate the left adrenal vein and left gonadal vein. This can be considered a relatively limitation of this study since the adrenal vein and gonadal veins are tributary of the left renal vein in almost all individuals. For an adequate and global evaluation of the living donor who is going to be operated by a laparoscopic nephrectomy, some institutions, including ours, prefer the utilization of magnetic resonance imaging. MR-angiography presents 89.4% sensitivity, 94.1% specificity and 90.6% accuracy for the demonstration of the arterial anomalies. For demonstration of the venous anomalies MR-angiography has 98.3% sensitivity, 100% specificity and 98.4% accuracy. One of the greatest advantages of MR over CT angiography is the fact that MR does not use ionizing radiation. For these reason we can perform, as many acquisition are necessary in order to obtain a complete evaluation of the living donor. However, one of the main limitations of MR imaging is its inability to demonstrate urinary stones particularly those located in the renal parenchyma. This interesting study suggests that venous phase imaging is not necessary for the evaluation of renal vein anatomy. However, a large number of patients need to be studied using this single phase protocol in order to validate this conclusion.

References

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