# Comparison of Gleason scores and MR Spectroscopic Imaging in Prostate Cancer Patients

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**Introduction**: Prostate cancer is the second most common cause of cancer death in American males and the leading cause of cancer death in males over 85. The causes of prostate cancer are largely unestablished, but the main risk factors seem to be increasing age, family history, African descent, and various aspects of diet. In patients with prostate cancer, Gleason scores (GS) at biopsy (1– 2) and at post surgical pathologic evaluation (3) are important factors in predicting outcome, regardless of therapy. Thus, a noninvasive technique that could be used to assess prostate cancer aggressiveness and accurately predict the pathologic GS could make a substantial contribution to the decision-making process in patients with prostate cancer. In spite of a limited coverage facilitated by an endorectal surface coil, MR spectroscopic imaging (MRSI) permits non-invasive biochemical characterization in the entire prostate gland. Addition of MRI to proton ($^1$H) MRSI has shown biochemical and anatomical detection of cancer in the prostate peripheral zone (4). A goal of the current study is to determine whether metabolic information provided by MRSI could be used to predict the aggressiveness of prostate cancer.

**Methods**: A total of 28 patients with prostate cancer (median age, 59 years; age range, 45–79 years) who underwent endorectal MR imaging and proton MR spectroscopic imaging were included in this study. All patients gave informed consent according to an institutionally approved research protocol. A 1.5 Tesla MRI Scanner with high performance gradients (Avanto, Siemens Medical Solutions, Erlangen, Germany) was used for this investigation. An endorectal inflatable coil (Medrad Corporation, Indianola, PA) was then inserted in the rectum and inflated with 90cc of air. The coils were positioned horizontally at approximately the 10 and 2'o clock positions. $T_2$- weighted images in the transverse, sagittal and coronal planes were acquired by using a turbo spin-echo sequence. MR spectroscopic imaging (MRSI) was performed in all patients which included a three dimensional (3D) water and fat suppressed spectroscopic acquisition (5). MRSI parameters were as follows: TR 700ms, TE 120ms, acquisition bandwidth 1300 Hz, 6 averages, and 512 spectral data points. Field of view was 80x80x80 $mm^3$ and raw matrix size 512x12x12x8. A PRESS based sequence was used to acquire proton MR spectra from a volume of interest (VOI) of approximately 55x30x40 $mm^3$(6) Outer volume suppression of water and lipid was achieved using eight 3-cm thick saturation pulses around the VOI. Total acquisition time was approximately 12 minutes. After apodization of the acquired MRSI data, a voxel could best be approximated by a sphere with a diameter of 12.5mm and a volume of 1.0$cm^3$. The raw data were processed online using the Siemens post-processing package. Patients' Gleason scores were derived from the robotic-assisted prostatectomy specimens.

**Results and Discussion**: The areas under the peaks of citrate (Cit), creatine (Cr) and choline (Cho) resonating at different positions in the 3D MRSI spectrum are proportional to the concentrations of these metabolites. The respective changes in the concentrations can be used to identify cancer with reasonably high specificity. For the malignant patients, the mean and SD of (Cho+Cr)/Cit) of GS (3+3, 3+4, 4+3 and 4+4) were as follows: 1.04±0.58, 1.16±0.72, 2.10±0.64 and 2.65±0.25. There were significant differences in the (Cho+Cr)/Cit ratios of four groups of various GS (p=0.008, one-way ANOVA). MRSI is the only imaging technique that can provide a non invasive evaluation of tumour aggressiveness in prostate cancer. There was a trend towards increasing (Cho+Cr)/Cit with increasing Gleason score in lesions identified correctly with MR spectroscopic imaging. Correlation between metabolite ratio and different Gleason score groups identified at step-section pathologic evaluation has been assessed (7). This current work demonstrates that there is an increased level of choline and decreased level of citrate with increase in Gleason score derived from robotic-assisted prostatectomy.

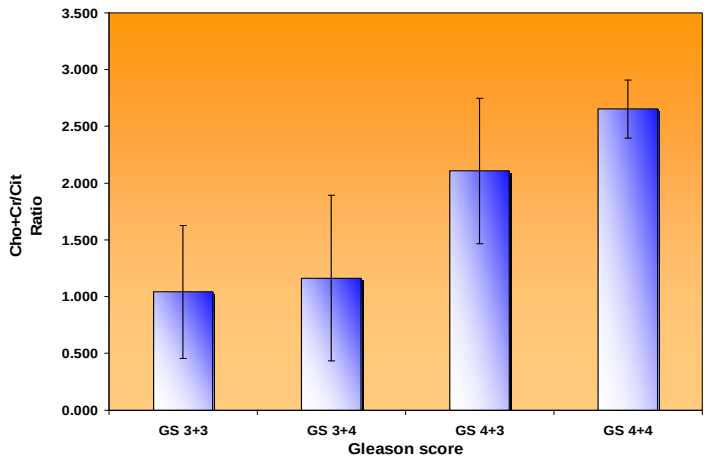


Fig.1. The metabolite ratios of (Cho+Cr)/Cit versus Gleason score values.

**Conclusion:** Our pilot findings demonstrate that the metabolite ratios recordable from 3D MRSI prostate cancer can be valuable non invasive markers of the grade of malignancy with higher ratios reflecting higher grade of malignancy. However, these findings need to be evaluated in a larger patient cohort.

## References

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