INTRODUCTION

• Clear Cell Renal Cell Carcinoma (CCRCC) is the most common type of renal cell carcinoma (RCC) originating from the renal parenchymal urothelial system.

The pathological characteristics of CCRCC can be classified into four grades according to the Fuhrman nuclear grading system. The major requirement to correctly treat tumors is knowledge of their sub-type, location, and aggressiveness.

Computed tomography texture analysis (CTTA) is a method to quantify a tumor’s heterogeneity, which contains information about the nature of the tumor.

OBJECTIVES

• Extract texture features and histogram-based features from CT scans of CCRCC.
• Classify into sub-types using a trained classification model.
• Determine whether this could be a reference for physicians to define the types of tumors and thus to provide suitable treatment. A reliable CT-based grading method could reduce the number of kidney biopsies required prior to therapy.

PATIENT & TUMOR DEMOGRAPHICS

<table>
<thead>
<tr>
<th>Patient &amp; Tumor Demographics</th>
<th>CCRCC Tumors</th>
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<tbody>
<tr>
<td>Patient N = 24</td>
<td>Grade 1: n = 2</td>
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<tr>
<td>Male: 14</td>
<td>Grade 2: n = 11</td>
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<tr>
<td>Female: 10</td>
<td>Grade 3: n = 12</td>
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<td>Mean Age: 57.7 (range: 25-87)</td>
<td>Grade 4: n = 1</td>
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<td>Mean size = 2.6 cm ± 0.8 cm (1.2 – 3.9 cm)</td>
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METHODS

Each tumor had three slices – one each from the superior, mid, and inferior aspects of tumor.
• The tumor region was cropped by an experienced radiologist. Each image of a tumor is centered in an image of size 100 by 100 pixels.
• 44 texture features (GLCM, GLRLM, Hu’s Moments) and histogram-based features are extracted from normalized tumor images (mean, variance, kurtosis, skewness, energy).
• Rank the features by AUC value (area under the ROC curve).
• A random-forest (RF) classification algorithm was developed to classify the grade of CCRCC.
• Use patient-based 5-fold cross validation.
• The RF classifiers were trained to classify CCRCC.
• The final AUC values after classification were calculated in the patient-based case by adjusting the cost matrix in the random-forest algorithm.
• Run 20 times to get final results for each trial.

RESULTS

• Grades 1 and 2 are combined as a "low-grade" group; grades 3 and 4 were combined as a "high-grade" group.
• We treat each patient as a unit to do experiments.
• If two or more slices are correctly classified, then we decide that patient is correctly classified.

CONCLUSION & FUTURE WORK

• The random forest classifier has the potential to classify CCRCC accurately.
• ‘Low VS High’ got better results than ‘Grade 2 VS Grade 3’.
• We expect further improvement as more data are acquired and other classification methods are evaluated.

REFERENCES