

## Qualitative and quantitative assessment of intrahepatic cholangiocarcinoma using diffusion weighted imaging with histopathologic correlation: preliminary results from a bi-center series.

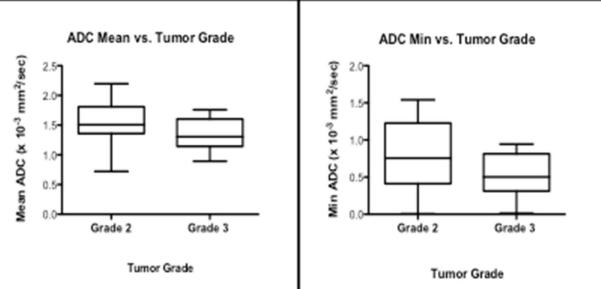
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**Target Audience:** Radiologists and physicists interested in cancer applications of DWI.

**Purpose:** Intrahepatic cholangiocarcinoma (ICC) is the second most common primary liver cancer and is associated with poor outcomes. ICC tumor grade at pathology may affect overall patient prognosis [1]. ADC quantification using DWI has shown potential to predict the grade of hepatocellular carcinoma, with an inverse correlation between ADC and tumor grade [2]. Preliminary work has described the qualitative DWI appearance of ICC, including description of the “target appearance”, consisting of peripheral diffusion restriction with central iso/hypointensity, which is believed to represent peripheral areas of active tumor growth/angiogenesis and central areas of fibrosis [3]. However, there are no reports evaluating the relationship between quantitative ADC and ICC tumor grade. The objective of this study is to determine the qualitative and quantitative DWI characteristics of ICC and correlate with histopathologic tumor grade.

**Materials and Methods:** In this IRB-approved bi-center retrospective study, we included consecutive patients with pathology proven ICC who underwent pre-treatment MRI including DWI from 4/2010 to 6/2014. Lesion conspicuity (LC) for low (50) and high b-value (500-1000) DWI was assessed using a 5-point scale (0: not visible; 5: very well seen). Diffusion restriction pattern was qualitatively assessed on high b-values. ROIs were placed in the ICC lesions on diffusion images in order to extract  $ADC_{mean}$  and  $ADC_{min}$  excluding necrotic areas. Tumor grade was categorized pathologically as well (G1), moderately (G2), or poorly differentiated (G3).  $ADC_{mean}$  and  $ADC_{min}$  were compared between different tumor grades using the Mann-Whitney U test. Spearman correlation was computed to assess correlation between ADC and tumor grade.



Box Plot distribution showing a trend towards lower ADC Mean and ADC Min values in G3 ICC compared to G2 ICC, without reaching statistical significance.

**Results:** Preliminary results from 25 patients are reported here. 31 lesions were assessed (mean size  $63 \pm 37 \text{ mm}$ ) as follows: G2 (n=20) and G3 (n=11). All lesions were seen on high b-value (mean LC score  $4.7 \pm 0.6$ ). 21/31 (68%) lesions demonstrated diffuse diffusion restriction while 10/31 (32%) demonstrated a target appearance.  $ADC_{mean}$  and  $ADC_{min}$  of G3 tumors ( $1.34 \pm 0.28$  and  $0.50 \pm 0.30 \times 10^{-3} \text{ mm}^2/\text{sec}$ , respectively) were lower than those of G2 ( $ADC_{mean} 1.56 \pm 0.30$  and  $0.77 \pm 0.46 \times 10^{-3} \text{ mm}^2/\text{sec}$ , respectively) without reaching significance ( $p=0.08$  and  $p=0.12$ , respectively). A trend towards significance was observed when correlating tumor grade and  $ADC_{mean}$  ( $r=-0.32$ ,  $p=0.08$ ), but not for  $ADC_{min}$  ( $r=-0.29$ ,  $p=0.11$ ).

**Discussion:** These preliminary results demonstrate that ICC shows high conspicuity on DWI, with only a third of lesions showing a target appearance on high b-value images, less than previously reported [3]. There was a trend towards lower ADC values for G3 tumors in this preliminary data, and a trend towards correlation between ADC and ICC tumor grade, which merits further analysis [4].

**Conclusion:** ICC is highly conspicuous on DWI images, and ADC quantification may potentially be useful for predicting tumor grade. These results need to be confirmed with a larger number of cases, with correlation with advanced pathologic techniques including tumor fibrosis and microvascular density quantification.



Fig: Target appearance of a moderately differentiated (G2) ICC on FS T2 (A), b500 (B) DWI and ADC map (C) in a 61 year old woman.

### References

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2. Nakanishi M. Ann Surg Oncol 2012;19(4):1302-9.
3. Park HJ. Abdom Imaging. 2013; 38(4):793-801.
4. Cui X. EJR 2012; 81 (11): 2961-2965.