

# Non-invasive assessment of fibrosis by Magnetic Resonance Imaging: Validation of a novel index from T1 mapping and diffusion-weighted imaging in animals models and kidney allograft recipients.

L Berchtold<sup>(1)</sup>; I Friedli<sup>(2)</sup>; L A Crowe<sup>(2)</sup>; S Moll<sup>(3)</sup>; K Hadaya<sup>(1)</sup>; T de Perrot<sup>(2)</sup>; C Vesin<sup>(4)</sup>; PY Martin<sup>(1)</sup>; JP Vallée<sup>(2)</sup>; S de Seigneux<sup>(1)</sup>

(1) Division of Nephrology, Geneva University Hospitals, Geneva, Switzerland; (2) Division of Radiology, Geneva University Hospitals, Geneva, Switzerland; (3) Division of Pathology, Geneva University Hospitals, Geneva, Switzerland; (4) Division of Cell Physiology and Metabolism, Geneva University Hospitals, Geneva Switzerland

## INTRODUCTION

Renal interstitial fibrosis is a common process to kidney diseases and is predictive of renal prognosis. Therefore, its evaluation is of prime importance in CKD patients.

Interstitial fibrosis is assessed by renal biopsy, an invasive procedure associated with complications, inaccuracies and bias. There is currently no clinically noninvasive tool to evaluate precisely interstitial fibrosis.

Diffusion MRI is a new tool to evaluate kidney fibrosis non invasively. Up to now, low image resolution and interindividual variations limited its clinical use.

## AIMS AND METHODS OF THE STUDY

To compare a new optimized MRI diffusion sequence called "RESOLVE"<sup>a</sup> with T1 mapping to predict interstitial fibrosis (RESOLVE = REadout Segmentation Of Long Variable Echo train).

First, we validated the new sequence in two rat models of fibrosis: unilateral urinary obstruction (UUO) and inflammatory nephritis (IN).

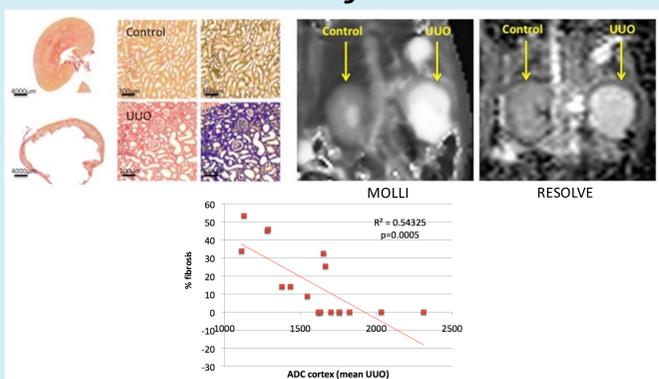
Then, 33 kidney allograft patients undergoing kidney biopsy were examined using MRI: T1 mapping and Diffusion Sequence (RESOLVE)

The association between renal ADC (apparent diffusion coefficient) values and histological fibrosis or inflammation assessment was investigated using Pearson's tests after controlling the linear associations with scatter plots.

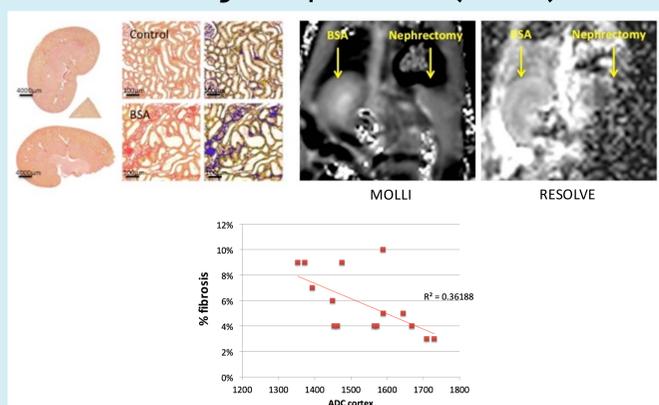
Both automated and visual analysis of histological fibrosis were performed.

## RESULTS IN RATS MODELS

### UUO: unilateral urinary obstruction



### IN: inflammatory nephritis (BSA)



## RESULTS IN PATIENTS

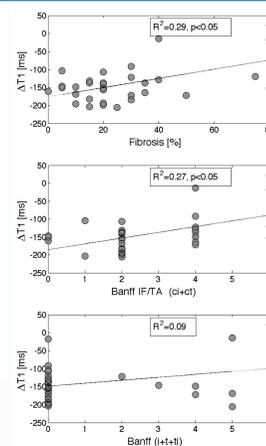
In order to decrease interindividual variability, we derived a new index expressed as the difference between cortical and medullary values:

$$\Delta T1 = T1 \text{ Cortex} - T1 \text{ medulla}$$

and

$$\Delta ADC = ADC \text{ cortex} - ADC \text{ medulla}$$

### RESULTS: T1

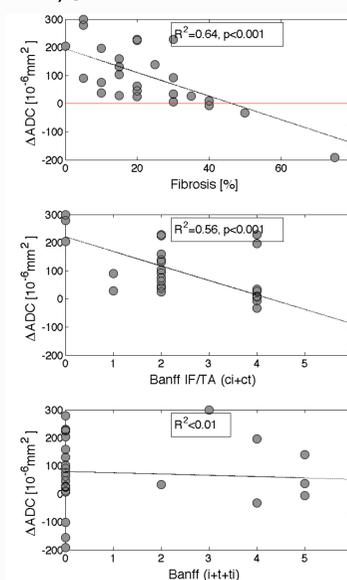


Delta T1 correlated to histological fibrosis ( $R^2 = 0.29$ ) and Banff IF/TA.

Delta T1 was not helpful for evaluation of inflammation

### RESULTS: RESOLVE

- In kidney allograft patients undergoing biopsy, delta ADC correlated to histological fibrosis percentage as assessed by the pathologist and by automatized methods ( $R^2 = 0.64$ ,  $P < 0.001$ ). In addition, we observed negativization of delta ADC values for patients harboring more than 40% interstitial fibrosis.



Using delta ADC allowed a better correlation to fibrosis and minimized interindividual variation.

Delta ADC did not discriminate for the severity of inflammation

Delta ADC outperformed Delta T1 with a stronger negative correlation to fibrosis ( $R^2 0.64$  vs  $R^2 0.29$ ).

## CONCLUSIONS

- Optimized diffusion MRI and delta ADC index appear:
- to be useful in assessing the severity of interstitial fibrosis in kidney allograft recipients and CKD patients.
  - to show promise as a non-invasive and effective technique to guide therapy and follow-up in CKD patients.

## REFERENCES

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