Feasibility of noninvasive quantitative measurements of intrarenal R(2)' in humans using an asymmetric spin echo echo planar imaging sequence.

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Purpose:
The objective of our study was to prospectively investigate the feasibility of Asymmetric Spin Echo single-short EPI (ASE-EPI) MRI for the measurement of R2' of renal cell carcinoma (RCC), and assess the difference between the R2' of RCC and renal cortex.

Methods:
A total of ten healthy subjects and twenty patients with renal solid lesions found on either ultrasound or CT were included in the study. All of the experiments were conducted preoperatively on a 3.0 T whole-body MR scanner (Signa ExciteTM; GE Medical Systems, Milwaukee, Wisconsin, USA). The ASE-EPI protocol included one spin echo and 19 asymmetric spin echoes. The 19 ASE images were acquired using different 180° pulse offset time (τ) ranging from 10.75 ms to 24.25 ms with an increment of 0.75 ms, and one SE image at τ = 0ms. The reversible R2' decay time is 2τ. Other parameters were TE = 65ms, TR = 1000ms, Field of View = 240mm*240mm, matrix size = 96*64, slice thickness = 6mm, number of slices = 8, and the total data acquisition time for the ASE-EPI sequence was 20s. We measured the R2' value of renal mass, as well as renal cortex and medulla of healthy subject.

Results:
Eighteen RCCs and two AMLs (angiomyolipoma) were confirmed pathologically after surgery. The mean R2' values of RCC, AML, normal renal cortex and medulla were 24.19±9.26 Hz, 26.86±5.16 Hz, 16.10±3.29 Hz, 18.2±3.79 Hz, respectively. There was statistically significant difference between RCC and normal renal cortex in term of R2' (figure 1).

Discussion:
ASE-EPI sequence has been demonstrated to be a noninvasive and reproducible method to estimate the intrarenal R2', and R2' can reflect the intrarenal oxygenation changes [1]. The observed evaluations of R2' in the present study are likely. It is supposed pathologically that RCCs are rich in blood vessels and consume more oxygen than normal renal parenchyma, which results in much more deoxyhemoglobin and leads to higher R2' value.

Conclusion:
It is feasible to evaluate the R2' of RCC by using ASE-EPI MRI. R2' of RCC was higher than that of normal renal cortex.

Fig 1. Anatomical images and R2' mappings of RCC (a, c) and normal kidney (b, d) were shown. Color bar indicates the corresponding R2' from 0Hz to 50Hz.