

# DIFFUSION-WEIGHTED MR IMAGING OF KIDNEY AFTER INJECTION OF IODINATED CONTRAST MEDIUM: A TIME COURSE STUDY IN ANIMAL MODEL

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## Target audience

Radiologist and Nephrologist who focus on the functional MR imaging of kidney

## Purpose

To study the chronological effect of different contrast medium in intrarenal water diffusion with DWI

## Methods

Ten New Zealand white rabbits were divided into two groups. Five of them received iopamidol-370 with a dosage of 6 ml/kg body weight. The other five rabbits received 5.8ml/kg of iodixanol-320. The total iodine administered was equal between the 2 groups. MR studies were conducted in a 1.5T GE MR scanner with a knee coil. A sequential DW-MRI (0 and 500 s/mm<sup>2</sup>) was performed to estimate the intrarenal apparent diffusion coefficient (ADC) at 24 hours before and 1h, 24h after contrast administration. ADC values obtained in the cortex (CO), outer stripe of the outer medulla (OS), inner stripe of the outer medulla (IS) were grouped into "baseline", "1 h", "24 h" respectively. One-Way ANOVA and Fisher's LSD test were performed to test the intrarenal water diffusion as consequence of iodine administration within each group, and independent samples T test was performed to test the response between the two groups in each time course.

## Results

In iopamidol-370 group, the iopamidol induced little decrease in ADCs in the CO, OS and IS of the kidney by 1 hour, but produced a prominent decrease by 24 hour in the CO, OS and IS (LSD test,  $p = 0.009, 0.007, 0.014$  vs. baseline). No significant ADC changes were observed in each renal region after iodixanol-320 injection (LSD test,  $p > 0.05$  vs. baseline) both 1 h and 24 h after administration compared with baseline. The ADCs fell in the kidney by 1 hour, but went up slightly by 24 hour in the CO, OS and IS.

Between the two groups, there was no significant difference of ADCs in the CO, OS and IS before and 1 h, 24 h after administration ( $p > 0.05$ ).

## Discussion

Contrast-induced nephropathy (CIN) is a prevalent cause of renal inadequacy following intravascular injection of iodinated contrast medium (CM)<sup>1</sup>. The pathogenesis of CIN, however, is currently unclear<sup>2</sup>. The osmolality of contrast media is considered to play an important role in the pathogenesis of CIN<sup>3-5</sup>.

Many studies indicated that the iodinated CM produced a progressive reduction in intrarenal diffusion, particularly in IS of kidney<sup>6</sup>. Between the nonionic monomer, low osmolality CM (LOCM, iopamidol-370) and the nonionic dimer, isometric osmolality CM (IOCM, iodixanol-320), which one has less ill effect on intrarenal water diffusion? As for the LOCM (iopamidol-370) group, our result is similar. The change of ADCs illustrated that the contrast-induced functional deficiency in kidney developed 24 hours after injection, but we don't get the ADCs reduction immediately 1h after injection. As for the IOCM (iodixanol-320) group, no marked difference is found after injection although ADC values have indeed reduced a little. The interesting thing is the ADC values begin to increase slightly in the 24h although values are still less than baseline level. In another word, renal function begins to getting better at 24h, earlier than the LOCM group. The reason may be various, but that the osmolality of iodixanol-320 is similar to that of plasma is the first reason to take into account.

## Conclusion

DW-MRI is a preeminent noninvasive method for quantitative evaluation of renal function in contrast-associated rabbit kidney models. Our time course study indicates that some differences do exist on the renal transport function in the two kinds of iodinated CM. This may be helpful to understand the pathogenesis associated with CIN.

Time course	ADC $\times 10^{-3}$ mm <sup>2</sup> /s (N=5)		
	CO	OS	IS
Baseline	2.03±0.18	2.15±0.21	1.90±0.20
Post-1h	1.80±0.07	1.85±0.10	1.74±0.10
Post-24h	1.67±0.26*	1.70±0.28*	1.46±0.35*

Table 1: Time course ADC changes in different renal regions with injection of iopamidol-370

Time course	ADC $\times 10^{-3}$ mm <sup>2</sup> /s (N=5)		
	CO	OS	IS
Baseline	1.96±0.31	1.99±0.30	1.76±0.25
Post-1h	1.82±0.50	1.79±0.42	1.61±0.40
Post-24h	1.84±0.35	1.82±0.36	1.62±0.32

Table 2: Time course ADC changes in different renal regions with injection of iodixanol-320

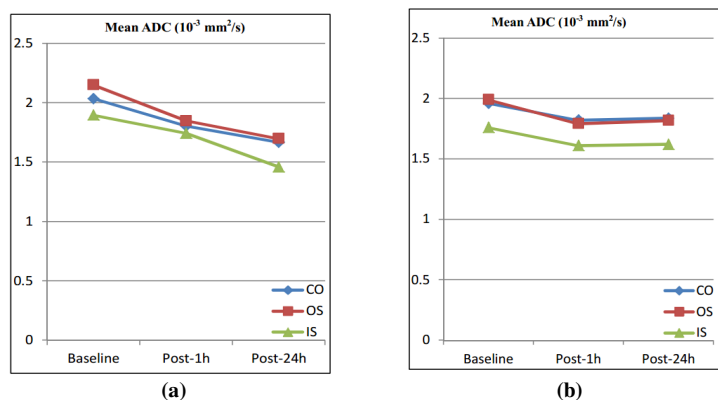


Figure 1: Sequential ADC changes following injection of iopamidol-370 and iodixanol-320 in different renal compartments, with different curve types

(a) A reduction in intrarenal ADCs were observed by the 1h and 24h after iopamidol-370 injection, with significant difference by 24h after administration compared with baseline.

(b) Iodixanol-320 didn't produce any statistically significant alteration in each renal compartment. The mean ADCs all went up slightly by 24h after administration in the CO, OS and IS.

## References

1. R Mehran, E Nikolsky. Contrast-induced nephropathy: definition, epidemiology, and patients at risk. *Kidney International*. 2006; 69: S11-S15.
2. Tumlin J, Stacul F, Adam A, et al. Pathophysiology of contrast-induced nephropathy. *Am J Cardiol*. 2006; 98(6A):14K-20K.
3. Lancelot E, Idée JM, Laclède C, et al. Effects of two dimeric iodinated contrast media on renal medullary blood perfusion and oxygenation in dogs. *Invest Radiol*. 2002; 37(7):368-375.
4. McCullough PA, Bertrand ME, Brinker JA, et al. A meta-analysis of the renal safety of isosmolar iodixanol compared with low-osmolar contrast media. *J Am Coll Cardiol*. 2006; 48(4):692-629.
5. Heinrich MC, Kuhlmann MK, Grgic A, et al. Cytotoxic effects of ionic high-osmolar, nonionic monomeric, and nonionic iso-osmolar dimeric iodinated contrast media on renal tubular cells in vitro. *Radiology*. 2005; 235(3):843-849.
6. Wang J, Zhang Y, Yang X, et al. Time course study on the effects of iodinated contrast medium on intrarenal water transport function using diffusion-weighted MRI. *J Magn Reson Imaging*. 2012; 35(5):1139-1144.