MR angiography in rabbits: Comparison of a new blood pool contrast agent with Dotarem®

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Introduction: Contrast-enhanced MR angiography (MRA) has replaced diagnostic catheter angiography as the imaging technique of first choice [1, 2]. However, due to the short intravascular half-life time extracellular paramagnetic gadolinium chelates only provide a short time frame for data collection. Therefore, optimal timing of the contrast bolus is a prerequisite for good image quality. Furthermore, the rapid diffusion into the interstitial space may result in a concomitant enhancement of the surrounding tissues, decreasing the contrast between vessels and adjacent structures. Intravascular contrast agents may overcome these limitations of extracellular compounds. The study aimed to compare a new intravascular contrast agent for MR-angiography based on ultrasmall iron oxide particles (P904, Laboratoire Guerbet, France) with Dotarem® (Laboratoire Guerbet, France), a standard extracellular compound.

Methods and Materials: 6 rabbits underwent 2 MRA examinations on different occasions using both Dotarem® (0.1mmolGd/kg) and P904 (0.05mmol$_{Fe}$/kg) in random order. All measurements were performed on a 1.5T MR (Magnetom Espree®, Siemens, Germany). The examination protocol was kept constant for all examinations. The rabbits were anaesthetized and placed between two multi-channel phased array coils. 3D contrast enhanced MRA (TR = 5.1ms; TE = 1.78ms; flip angel = 30°; slice thickness= 0.7 mm; acquisition time = 20sec; FOV = 210mm) of the abdominal aorta, including visceral side branches and iliac arteries were performed prior to the application of the contrast medium, during the bolus phase and every minute up to 10 minutes thereafter. Two experienced radiologists evaluated the images qualitatively by consensus (4= excellent, 3= good, 2= moderate and 1= non-diagnostic). SNR and CNR of the arteries were calculated. For statistical evaluation a Wilcoxon test was used.

Results: In the bolus phase the average aortic SNR and CNR were significantly higher with Dotarem®(figure 1A) than with P904 (figure 1C) (SNR_{Dota}=46.5; SNR_{P904}=29.5 / CNR_{Dota}=38; CNR_{P904}=22; p=0.03). In the post-bolus phase ten minutes after injection P904 demonstrated an approximately 3-fold higher aortic SNR and nearly 5-fold higher CNR compared to Dotarem® (SNR_{Dota}=10; SNR_{P904}=29 / CNR_{Dota}=4; CNR_{P904}=21.5; p=0.011). Image quality (IQ) was rated excellent for P904 images at all time points (IQ $Bolus_{P904}$= 4.0; IQ $10min_{P904}$ = 3.7) whereas with Dotarem® only the bolus phase was rated excellent (IQ $Bolus_{Dota}$=4.0). More than 3 minutes after injection of Dotarem all images were assessed as non-diagnostic (IQ $10min_{Dota}$=1.2, figure 1B).

Conclusion: P904 as new blood pool agent appears to be well suited for high-quality first pass and steady-state MRA.

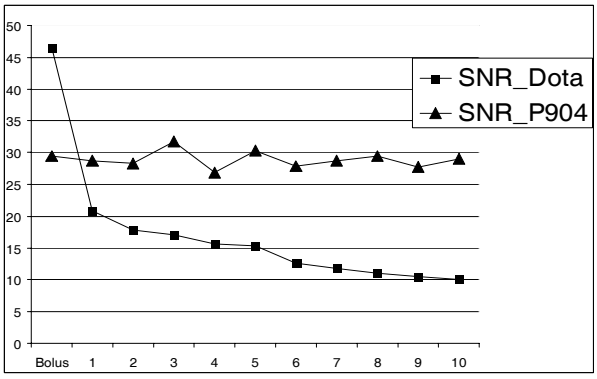

Fig.1: SNR over time for Dotarem and P904.

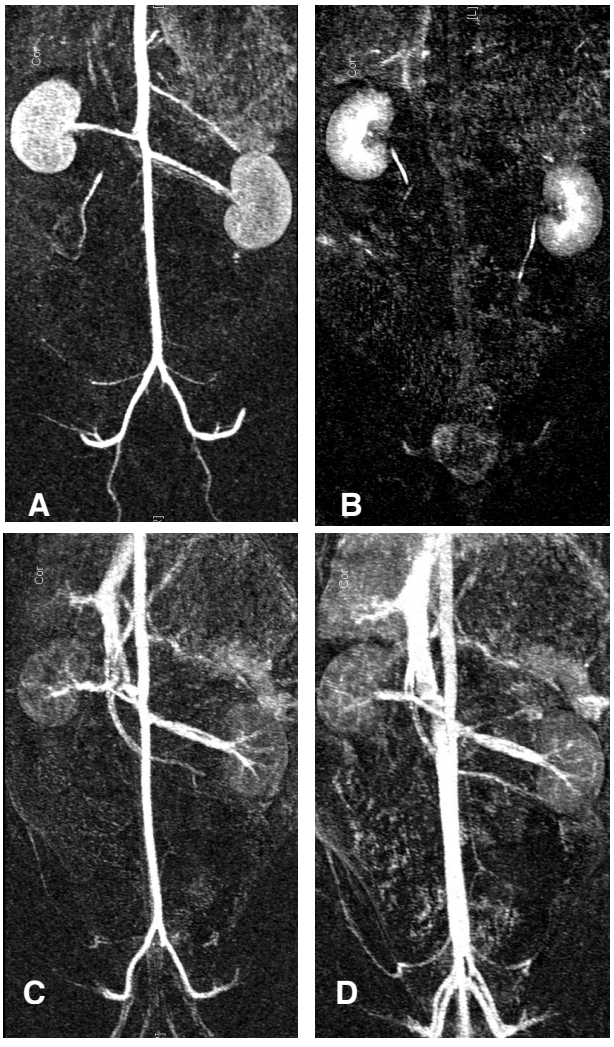

Fig.2: MR angiographies using Dotarem (A, B) and P904 (C, D) in the bolus phase (A, C) and 3 minutes after contrast injection (B, D).

References

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