Visualization of seminiferous tubules by high resolution MR imaging in rat testes: the usefulness in the evaluation of spermatogenic activities

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Introduction: The bulk of volume of the testes consists of many seminiferous tubules lined by a stratified epithelium composed of germ cells and Sertoli cells. In the tubular lumen numerous spermatozoa are bathing in seminiferous tubular fluids. We succeeded in the visualization of the normal seminiferous tubules of rats *in vivo* using MR imaging with high spatial resolution and high tissue contrast. Further, to determine the usefulness of high resolution MRI for the evaluation of status of spermatogenesis, we investigated the changes in appearances of the seminiferous tubules of rats treated with some chemical reagents. The chemical reagents used here were glycerol and diethyltilbestrol (DES), both of which chronically impair spermatogenesis. The anti-spermatogenic effect of glycerol is attributed to the hyperosmotic effect and the disruption of blood testis barrier [1, 2], and that of DES to the decreased serum levels of gonadotropin and androgen.

Methods: All the measurements were performed using INOVA spectrometer (Varian, Inc. CA. USA) equipped with a 4.7 T magnet. A home-built quadrature surface coil was used for transmitting RF pulses and acquiring signals. Male adult Wistar rats were administered 350 µl solution of 10 % glycerol to the unilateral testis using a 27 G needle, and the contralateral testis was saved as the control. Another group of rats received subcutaneous injection of 15 mg / kg body weight of DES altogether in three times. Several weeks after the administration, spin echo (SE) T_2 weighted images (T2WI, repetition time (TR) / echo time (TE) = 4000 / 100 ms) were obtained with a field of view of 34 x 34 mm, a matrix of 512 x 512 (in-pane resolution of 66 µm), and a slice thickness of 2 mm. Findings of the testes in the MR images were compared with those in the histological specimens.

Results and discussions: T2WI demonstrated that the numerous cross sections of thin tubular structures were closely arranged in various directions within the normal testis. Each tubular structure showed low signal in the periphery and high signal in the center. We assigned them as the seminiferous tubules based on the similarity in their appearance in MRI *in vivo* and *ex vivo*, and in the histological specimen. In both glycerol and DES administered rats, T2WI (Figure) demonstrated that the affected testes were significantly smaller in size, and the seminiferous tubules were globally appeared to be thinner, compared with those in the control, which were histlogically confirmed. It was thought to reflect the moderately decreased number of germ cells in the seminiferous epithelium and the proportionally decreased amount of seminiferous tubular fluids in the lumen. Only in the glycerol administered testes, low signal infiltrations were focally demonstrated on T2WI (Figure), reflecting coagurative necrosis of the seminiferous epithelium and intense proliferation of interstitial cells and fibro-connective tissue intervening the seminiferous tubules, which were not identified in the case of the DES administration. Conversely, the presence of such additional abnormalities on MRI may be the sign of severe damage in the seminiferous tubules and/or in the interstitial space of the testes.

Conclusion: Normal seminiferous tubules of rats were successfully visualized by high resolution MRI. High resolution MRI is promising for the evaluation of the status of spermatogenesis via detecting the changes in appearance of the seminiferous tubules.

References: [1] J Androl 1994;15(3):234-243. [2] J Androl 2000; 21(5):625-635.

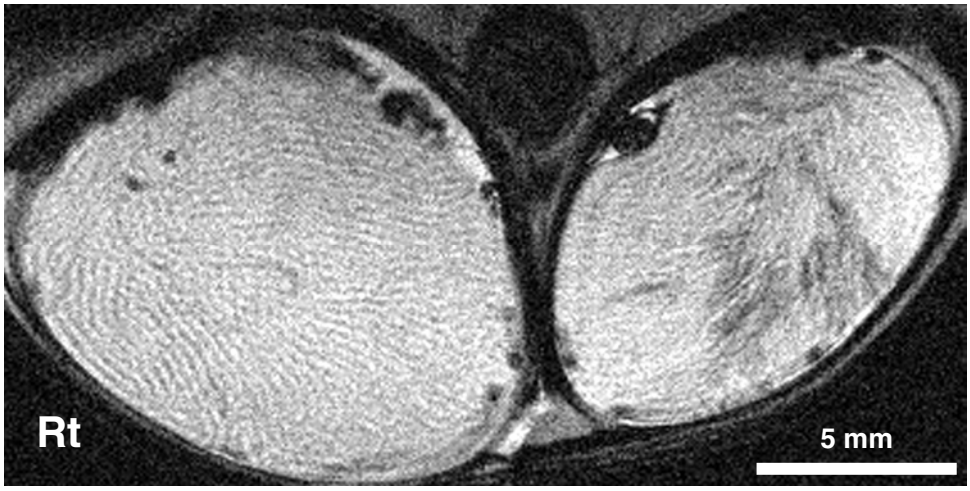

Figure: A T2WI of the scrotum of the rat 4 weeks after the glycerol injection to the left testis. In the right testis (control), a numerous number of the cross section of seminiferous tubules with high signal in their central part and lower signal in their peripheral part is clearly demonstrated. In contrast to this, the left testis shows smaller in size and the seminiferous tubules appear to be thinner. In addition, an ill-demarcated low signal infiltration is focally identified.