In vivo and *ex vivo* MRI of rat testis: A comparison with some conventional measurements

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Introduction

MRI has been little used in the examination of testicular pathology in animal models of disease (1-3). Such testicular pathology is a frequent observation in pharmacological and/or toxicological studies (4). In this work we demonstrate *in vivo* and *ex vivo* that MRI can be applied to examine some gross features of the testis that may be adversely affected by pharmaceutical intervention.

Methods

In vivo images were acquired at 2 T (Bruker Medspec S200) using a 10 cm i.d. birdcage resonator. A spin-echo sequence (TE 17, TR 2000, 256x256 matrix, 110x110 mm FOV, 16x2 mm slices, NEX 2, scan time ca. 17 minutes) was used. Three rats (ca. 500 g) were anaesthetised (1.5% isoflurane in medical air) for MRI. Testicle volumes (n=6) were assessed manually and data are presented as the mean of two independent measurements. Conventional *in vivo* volume assessments were also performed using weight measurements of testes excised immediately post MRI.

Ex vivo images were acquired at 7 T (Bruker Biospec) using a 3.5 cm i.d. birdcage resonator. A 3D RARE sequence (16 echoes, TE_{eff} 110ms, TR 600ms, 256x256x256 matrix, 25.6x25.6x25.6 mm FOV, NEX 28, 20 hour scan time) was used. Four rats (ca. 500 g) were examined. Testes were removed, dissected free of epididymal fat, fixed for 24 hours in Bouin's fixative and stored in 70% methylated spirits. Testes were sectioned and stained (H and E) for conventional histological assessment.

Results

Mean(SD) testicle volume, assessed by MRI was 2.11(0.19) cm^3 and the mean post mortem wet weight was 1.79(0.12) g. These independent measurements correlated with r=0.88.

Figure 1 shows four contiguous axial slices through the scrotal region of an anaesthetised rat. In addition to the the testes (A) a number of other anatomical structures are clearly delineated including segments of the epididymis (B), epididymal fat deposits (C), and elements of the spermatic cord (D). These features were clearly visible in all animals.

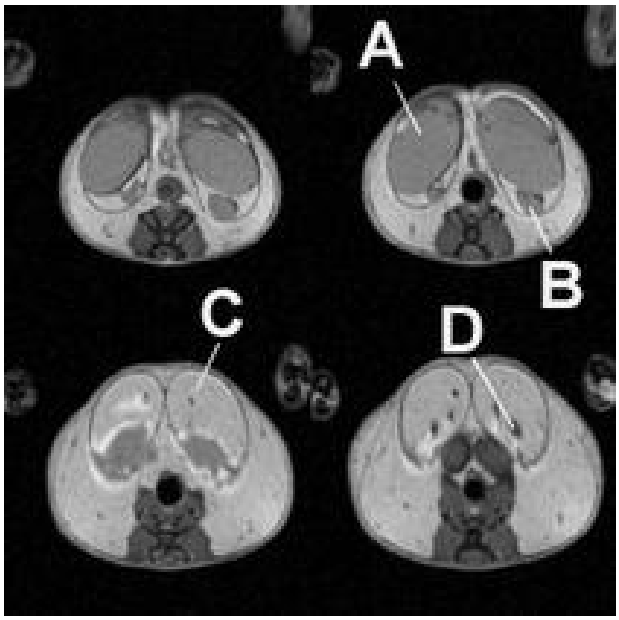

Figure 1

The modest resolution applied here *in vivo* did not allow the examination of smaller structures. The *ex vivo* data, however, did allow a clear visualisation of the seminiferous tubules. Figure 2 shows a slice (100 µm thick) through a 3D MRI data set, along with an H+E stained histological section (3 µm thick) from the same testicle. Boxes in both images highlight regions in which seminiferous tubules have been transsected predominantly transversely (A), and longitudinally (B). (Scale bars = 2mm).

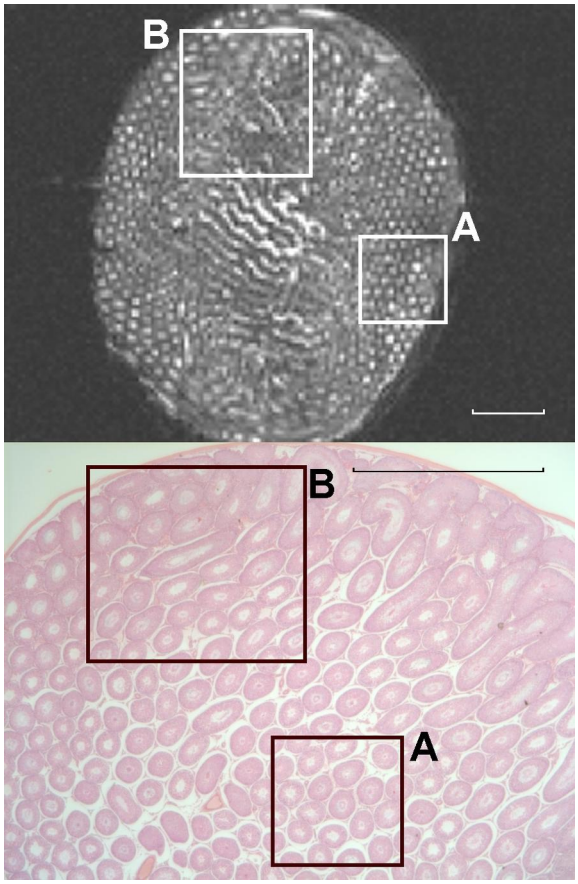

Figure 2. Comparison of MRI and histology

Discussion

Major structures of the testes, in which pathological change often occurs in response to drug treatment can be successfully examined either *in vivo* and/or *ex vivo*. The correlation of volumetric MRI data and the more conventional wet weight data suggest that volumetric measurements are an accurate estimate. *In vivo* volumetric analysis by MRI will allow the rapid non-invasive and serial assessment of testicular growth and shrinkage where it occurs. Unlike conventional histological preparations in which only selected pre-defined slices of tissue are prepared for examination, high-resolution *ex vivo* examinations by MRI offer the opportunity to acquire data from the whole organ. This may prove a useful adjunct to normal histology in, for example, localising regions of interest for subsequent intensive histological preparations.

Conclusion

MRI can offer some significant advantages over standard pathological methods in the examination of the testes during toxicological studies, and is expected to become a powerful tool in the examination of experimental pathology in this organ.

References

1) R. A. Costabile et al.. J. Urology 151, 1070-2 (1994).
2) T.-c. Yeh et al.. Magn. Reson. Med. 33, 200-8 (1995).
3) I. Sasagawa et al.. Urol. Res. 26, 407-10 (1998).
4) John A Thomas in "Casarett & Doull's Toxicology": Ed. 5, C. D. Klaassen ed., pp. 547-81, McGraw-Hill, 1995.