In vivo stem cell tracking using magnetic resonance imaging in the rat genitalia of a radical prostatectomy model

Y. Oh[1], J. Kim[2], Y-M. Huh[1], M-J. Kim[1], and J-S. Suh[1]

[1]Diagnostic Radiology, Yonsei University College of Medicine, Seoul, Korea, Republic of, [2]Urology, Yonsei University College of Medicine, Seoul, Korea, Republic of

Introduction

Prostate cancer is the second most frequent cancer in men in USA and the fastest increasing incidence in Korea. Erectile dysfunction is a major complication after radical prostatectomy (1). It is believed that either direct damage or neuropraxia of the cavernous nerve leads to loss of corporal smooth muscle cells and subsequent fibrosis of the corpus cavernosum. There have been vigorous trials for improving erectile dysfunction but no satisfying method until now. Previous reports have shown that stem cell injection improves erectile function in a rat model erection dysfunction (2). However, they used the immunohistochemical stain for the evaluation of stem cell. The purpose of this study was to determine the feasibility of serial in vivo stem cell tracking using magnetic resonance (MR) imaging in the rat genitalia of a radical prostatectomy model.

Methods

We studied 36 male 5 weeks-old Sprague-Dawley rats (SLC, Tokyo, Japan). They are divided into 4 weeks, 8 weeks, and 16 weeks group and each group included 12 rats. Also, 12 rats of each group were divided into control and stem cell group and each group included 6 rats. Human mesenchymal stem cells (MSC) were labeled with superparamagnetic iron oxide particle (SPIO, Feridex®) and injected into the corpus cavernosum after transaction of bilateral cavernous nerves. In control group (n=18), cell-free media was injected into corpus cavernosum. The stem cell group (n=18) received $1x10^6$ cells in the same manner. MRI was obtained with a 1.5 T clinical MRI instrument with a micro-47 surface coil (Intera Achieva, Philips Medical Systems, Best, Netherlands). In vivo MRI to visualize Feridex-labeled MSCs were conducted by gradient echo sequence with the following parameters: T1-turbo field echo sequence, shortest TR and TE, flip angle=15°, matrix=256 x 256, slice thickness=3mm, number of averages=6, field of view=80mm. MRI was taken up to 16 weeks after normal media or MSCs injection.

Results

Magnetic resonance imaging showed a drop in signal intensity at the site of injection in the stem cell injected group. On serial MR imaging, the size of low signal intensity area showed decreased. The size of low signal intensity area showed much decreased around 12 weeks and at 16 weeks the low signal intensity were difficult to be visualized in most rats. On the other hand, there was no change in signal intensity at the injection site in the control group. (Fig. 1 and 2).

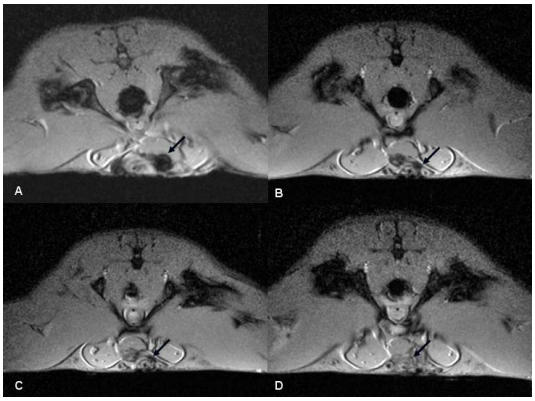

Fig. 1. **.** In vivo MRI with MSCs injection after transaction of bilateral cavernous nerves. (A-D) Short axis T1 weighted images of the rat with Feridex-labeled MSC injection shows the distinct signal dropout (arrow in A) at the penis in 4 weeks after injection . The size of signal dropout becomes decrease along the 8 (B), 12 (C), and 16 weeks

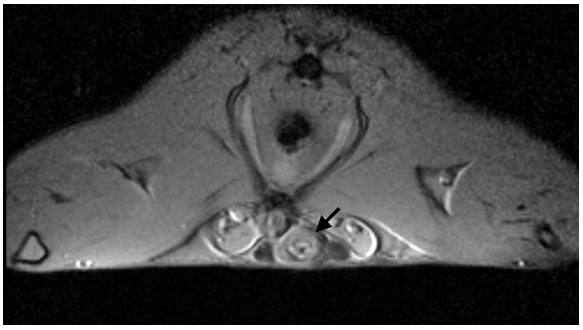

Fig. 2. . In vivo MRI with normal media injection after transaction of bilateral cavernous nerves. Short axis T1 weighted images of the rat with normal media injection shows no signal change at the penis (arrow).

Discussion and Conclusion

A reliable in vivo imaging method to localize transplanted cells and monitor their restorative effects will enable a systematic investigation of cell therapy. Our results showed that in vivo stem cell tracking using MR imaging in a rat model of radical prostatectomy was feasible. This may be a viable method for evaluating the fate of stem cells after injection into the rat penis.

References

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