

Normal Variations in the vertebral appearance on opposed-phase MRI: We need to know normal bone marrow appearance.

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Introduction

Opposed-phase (OP) study is an established method for assessing of fat and water components in the adrenal adenoma¹⁾. Recently OP MRI has been proven to be effective method for evaluating bone marrow infiltration in the spine^{2,3)}

The purpose of this study is to demonstrate normal vertebral bone marrow in normal individual and analyze the distribution of red and yellow marrow.

Subjects and Method

Two hundred forty-five subjects (125 males and 120 females, 16-89 years old [mean 65.8]) were entered the study. All subjects were studied with 1.5 T MRI units (Magnetom Quantum and Sonata, Siemens, Germany) with a phased array spine coil. In addition to the routine sequences such as T1-weighted images and fast STIR images, dual chemical shift sequences (FLASH, TR/TE/FA=140/2.3 and 4.7/70) were obtained. This sequence was obtained with TR of 140msec, one excitation, a 256x240 matrix, FOV 300x300, and 4mm thickness. We evaluated the signal intensity of lumbar spinal vertebrae of L3 and L4 visually. Bone marrow pattern was analyzed visually. Mean and SDs of age were calculated for each bone marrow pattern. The mean values of age were compared the Tukey-Kramer test using commercially available software (JMP; SAS Institute Inc.). Significance was defined at p less than 0.01.

Results

Bone marrow signal patterns were classified into five types on opposed-phase image (Fig.1) and the images were shown (Fig.2): Type 1(n=44) diffusely homogeneous hyperintensity; Type2 (n=48) Hyperintensity with a central hypointensity area; Type 3(n=64) Hyperintensity with multiple focal hypointensity areas; Type 4(n=55) Hypointensity with multiple focal hyperintensity areas; Type 5(n=7) Homogeneously diffuse hyperintensity.

Each bone marrow pattern was shown (Fig. 3). Bone marrow pattern show many normal variations with age. Older age above 45 year old showed Type 2, Type3 and Type 5. The mean SIRs and SD of age for the five types were as follows; Type 1: 46.7+/- 17.8, Type 2: 69.1+/-10.1, Type 3: 68.0+/-8.8, Type 4: 56.7+/-15.7 and Type 5: 75.0+/-3.3. Type 5 showed the highest mean age. Statistically significant differences (p<0.01) were seen on type 5 and other types by the Tukey-Kramer test (p<0.01) (Fig. 3).

Discussion and conclusion

In this study we showed normal variation patterns on opposed-phase image. Type 5 was significantly higher signal intensity than those of other type. Conversion of hematopoietic marrow to fatty marrow with advancing age is well known physiologic process⁴⁾. These results suggest type 5 may contain little water elements and almost only fat element, so this vertebra show homogeneous hyperintensity on opposed-phase image. However diffuse bone marrow metastases show diffuse homogeneous hyperintensity, resulting from a fat cell, so the bone marrow may contain rich water element of tumor cell and little fat cell. We must care diffuse hyperintensity on opposed-phase image.

In conclusion, the knowledge of normal marrow signal pattern on opposed-phase image was considered helpful for evaluation of hematological disorders.

Reference

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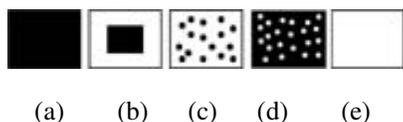


Fig. 1 Normal spinal vertebra variation
(a)Type 1 (b) Type 2 (c) Type 3 (d) Type 4
(e) Type 5



Fig. 2 (a) 32 year-old men (b) 48 year-old women
(c)67 year-old women (d) 52 year-old men (e) 73
year-old men

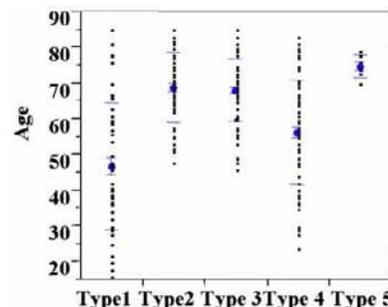


Fig. 3 Age distribution of bone marrow types