Three-dimensional visualization of abdominal and thoracic organs of rodents by superimposing MRI multislices with a computer-graphic technique.

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Using multislice MR images of thoracic and abdominal organs in laboratory small animals, three-dimensional (3-d) images were constructed by superimposing them on a computer with volume ray-tracing software. Rats and mice were anesthetized by pentobarbital. After anesthetization, the animals were intraperitoneally injected with the parasympathetic blocker scopolamine and fixed in a Helmholtz-type MRI probe with a stomach-band to prevent motion artifacts during taking of MR images. The positive contrast agent Ferri Seltz at the concentration of 10 g/l was orally administrated into stomach and duodenum cavities through a catheter just before taking the MR images. Two-dimensional (2-d) transversal multislices of MR images from thoracic to abdominal regions were taken with an SIS 300/183 MRI system with an ultra-high magnetic field of 7.05 T under the proton-weighing condition (the repetition period for the entire sequence TR=2000 ms and the echo time TE=20 ms). The slice thickness was 2 mm and the multislice spin-echo method was employed. Each organ (stomach, duodenum, liver, spleen, kidney, heart, born and spine) on MR images was pseudo-colored using a commercially available graphics program (Adobe Photoshop). The 3-d images were then constructed by superimposing these colored multislices on a UNIX computer by the volume ray-tracing method which was personally developed. In normal rats and mice, the thoracic and abdominal organs were visualized as pseudo-colored 3-d MR images. Transparent 3-d images were also constructed. The construction of 3-d images made it possible to clearly distinguish individual organs from other organs with respect to the position, size and shape. Furthermore, the pathological changes of tissues could be recognized by this 3-d MRI technique in BALB/c mice with liver tumors derived from the colon-26 line as well as in A/J mice with lung tumors induced by urethan. The foci of liver and lung tumors were identified in 3-d MR images of the abdominal region in these mice.

These results suggested that this 3-d technique for small animals was widely applicable to observe not only normal tissues but also pathological changes in various abdominal organs to judge the degree of progress of malignancy.