b) ^{1}H MRI.

Definitions and terms

For a better understanding of the present invention below are some terms used in this description of the invention.

In the description of this invention, the terms **"includes"** and **"including"** are interpreted as meaning "includes, among other things". These terms are not meant to be interpreted as "consists only of".

The term **"deuterated derivative"** in this document refers to a compound containing deuterium associated with carbon in excess of its natural content, at least in one position. In particular embodiments of the invention, the deuterium content, at least in one position, exceeds 30 %, in other particular embodiments – 90%. The "mixture of at least two different deuterated derivatives" refers to a mixture of compounds containing deuterium in different positions of the molecule, or containing different amounts of deuterium in the same position. The symbol "D" in this document denotes a hydrogen atom that is enriched with ^{2}H isotope with respect to its natural content.

The term "**voxel**" in this document refers to a volume element in the sample that is freely selectable by adjusting the parameters of the magnetic field and produces the signal of the nuclear magnetic resonance.

As used herein, **"pharmaceutically acceptable salt"** term refers to those salts which are, according to the medical conclusion, suitable for being used in contact with the tissues of humans and animals without excessive toxicity, irritation, allergic reactions, etc., and demonstrate a reasonable ratio of risks and benefits. Pharmaceutically acceptable salts of amines, carboxylic acids, phosphonates and other types of compounds are well known in medicine. Salts can be prepared *in situ* during the process of isolation or purification of compounds of the invention and can be obtained separately by reacting the free acid or free base compounds of the invention with the appropriate base or acid, respectively. Examples of pharmaceutically acceptable, nontoxic salts of acids include salts of an amino group formed with inorganic acids such as hydrochloric, hydrobromic, phosphoric, sulfuric and perchloric acid, or organic acids such as acetic, oxalic, maleic, tartaric, succinic or malonic acid, or obtained by other methods used in this field, for example, using ion exchange. Other pharmaceutically acceptable salts include adipate, alginate, ascorbate, aspartate, benzenesulfonate, benzoate, bisulfate, borate, butyrate, camphorcarboxylate, camphorsulfonate, citrate, cyclopentanepropionic, digluconate, dodecyl sulfate, ethanesulfonate, formate, fumarate, glucoheptonate, glycerophosphate, gluconate, hemisulfate, heptanate, hexanate, hydroiodide, 2-hydroxy-ethanesulfonate, lactobionate, lactate,

An animal with the weight of 210 g was injected intraperitoneally a solution of 150 mg of 2-amino-2-(CD_3)-3,3,3-D_3-propionic acid in 1.5 ml of a saline solution. After injection, the animal was kept in a separate cage with free access to food and water. To register the MR images and spectra an animal was immobilized with isoflurane. The surface transmitting-and-receiving coil was fixed over the head of the rat.

Figure 11 shows the MR image obtained for the rat with a tumor 4 hours after the administration of 2-amino-2-(CD_3)-3,3,3-D_3-propionic acid: (a) untreated ^2H MRI; (b) ^1H MRI; (c) superposition of ^2H MRI and ^1H MRI. This figure demonstrates that the signal of deuterium is localized in the region corresponding to the tumor according to ^1H MRI.

Figure 12 shows the MR image obtained for the rats without tumors 4 hours after the administration of 2-amino-2-(CD_3)-3,3,3-D_3-propionic acid: (a) untreated ^2H MRI; (b) ^1H MRI. This figure demonstrates that the signal of deuterium does not show a clear localization.

Based on the results illustrated by the figures 11 and 12, it can be concluded that the diagnostic agent according to the invention, in particular comprising 2-amino-2-(CD_3)-3,3,3-D_3-propionic acid can be used as a diagnostic agent for the detection of malignant tumors, including glioma, using ^2H MRI.

Despite the fact that the invention has been described with reference to the disclosed embodiments, for specialists in this field it should be obvious that the specific details of the described experiments are given only for the purpose of illustrating the present invention and they should not be construed as in any way limiting the scope of the invention. It should be understood that it is possible to implement various modifications without deviation from the essence of the present invention.

Claims

1. A diagnostic agent, including a deuterated derivative of 2-amino-2-methylpropionic acid and/or 2-(N-methylamino)-2-methylpropionic acid and/or its pharmaceutically acceptable salt, or a mixture of at least two different deuterated derivatives of 2-amino-2-methylpropionic acid and/or 2-(N-methylamino)-2-methylpropionic acid and/or its pharmaceutically acceptable salts, for diagnosis of oncological diseases by magnetic resonance imaging and/or magnetic resonance spectroscopy at the frequency of deuterium.

2. The diagnostic agent according to the claim 1, which further includes at least one pharmaceutically acceptable auxiliary substance.

3. The diagnostic agent according to the claim 2, in which the pharmaceutically acceptable excipient is a carrier, filler and/or solvent.

4. The diagnostic agent according to the claim 1, where the deuterated derivative of 2-amino-2-methylpropionic acid is 2-amino-2-(CD_3)-3,3,3-D_3-propionic acid or 2-amino-2-(CD_2H)-3,3,3-D_3-propionic acid or 2-amino-2-(CD_2H)-3,3,3-D_3-propionic acid or 2-amino-2-methyl-3,3,3-D_3- propionic acid or 2-amino-2-(CD_2H)-3,3-D_2-propionic acid or 2-amino-2-(CDH_2)-3,3-D_2-propionic acid or 2-amino-2-methyl-3,3-D_2-propionic acid or 2-amino-2-(CDH_2)-3-D-propionic acid or 2-amino-2-methyl-3-D-propionic acid.

5. The diagnostic medication according to the claim 1, wherein deuterated derivative of 2-(N-methylamino)-2-methylpropionic acid is a 2-methylamino-2-(CD_3)-3,3,3-D_3-propionic acid or 2-(N-(CD_3)amino)-2-methylpropionic acid or 2-(N-(CD_3)amino)-2-(CD_3)-3,3,3-D_3-propionic acid.

6. The diagnostic agent according to the claim 1, which comprises a mixture of at least two different deuterated derivatives of 2-amino-2-methylpropionic acid and/or 2-(N-methylamino)-2-methylpropionic acid selected from 2-amino-2-(CD_3)-3,3,3-D_3-propionic acid and/or 2-amino-2-(CD_2H)-3,3,3-D_3-propionic acid and/or 2-amino-2-(CD_2H)-3,3,3-D_3-propionic acid and/or 2-amino-2-methyl-3,3,3-D_3-propionic acid and/or 2-amino-2-(CD_2H)-3,3-D_2-propionic acid and/or 2-amino-2-(CDH_2)-3,3-D_2-propionic acid and/or 2-amino-2-methyl-3,3-D_2-propionic acid and/or 2-amino-2-(CDH_2)-3-D-propionic acid or 2-amino-2-methyl-3-D-propionic acid and/or 2-methylamino-2-(CD_3)-3,3,3-D_3-propionic acid and/or 2-(N-(CD_3)amino)-2-methylpropionic acid and/or 2-(N-(CD_3)amino)-2-(CD_3)-3,3,3-D_3-propionic acid.

7. The diagnostic agent according to the claim 1, which additionally includes non-deuterated 2-amino-2-methylpropionic acid or 2-(N-methylamino)-2-methylpropionic acid.

8. The diagnostic agent according to the claim 1, in which a deuterated derivative of 2-amino-2-methylpropionic acid or 2-(N-methylamino)-2-methylpropionic acid and/or its pharmaceutically acceptable salt besides the deuterium atoms attached to the

carbon atoms contains deuterium atoms that partially or completely substitute dissociable hydrogen atoms attached to oxygen and/or nitrogen atoms.

9. A method for diagnosing an oncological disease, comprising the following stages:

a) a diagnostic agent according to the claim 1 is administered to a subject;

b) the magnetic resonance imaging and/or magnetic resonance spectroscopy is carried out at the frequency of deuterium nuclei after administration of the diagnostic medication after a time sufficient for its accumulation in tumor tissue, for obtaining, respectively, a MR image and/or a NMR spectrum;

c) the presence or absence of an oncological disease is diagnosed based on the observed signal intensity of the deuterium nuclei, reflecting the level of accumulation of the diagnostic agent.

10. The method according to the claim 9, where in case of absence of accumulation regions of the diagnostic agent a subject is diagnosed with the absence of cancer.

11. The method according to the claim 9, wherein at least one additional medical study, selected from magnetic resonance imaging at the frequency of nuclei differing from deuterium, or ultrasound, or computed tomography, or X-ray, or palpation, or biopsy, or screening of biological materials for tumor markers, or radionuclide diagnosis or physical examination is carried out.

12. The method according to the claim 9, which diagnoses the presence or absence of an oncological disease based on the comparison of a signal intensity of the deuterium nuclei in the examined subject with a typical intensity of the signal observed in healthy subjects in the corresponding tissue or organ.

13. The method according to the claim 11, which diagnoses the presence or absence of an oncological disease based on the comparison of signal intensity of the deuterium nuclei in the regions corresponding to normal and pathological tissues according to an additional medical study.

14. The method according to the claim 11, which diagnoses the presence or absence of an oncological disease based on the comparison of a signal intensity of the deuterium nuclei in the neighboring voxels that are located at different sides of the interface between the normal tissue and the tissue suspicious for a tumor according to ^{1}H MRI.

15. The method according to the claim 11, which diagnoses the presence or absence of an oncological disease based on a comparison of deuterium images with the 1H magnetic resonance images from the same subject.

16. The method according to the claim 9, where the intensity of the deuterium signal and/or its change in time allows to make a conclusion on the structure, malignancy grade, aggressiveness, or degree of differentiation of the tumor.

17. The method according to the claim 9, wherein the oncological disease is breast cancer, glioma.

18. The method according to the claim 9, wherein during the registration of the image the selective excitation of deuterium nuclei included in the deuterated derivative of 2-amino-2-methylpropionic acid or 2-(N-methylamino)-2-methylpropionic acid and/or of its pharmaceutically acceptable salts, or of a mixture of deuterated derivatives of 2-amino-2-methylpropionic acid and/or 2-(N-methylamino)-2-methylpropionic acid and/or its pharmaceutically acceptable salts is used.

19. The method according to the claim 9, wherein during the registration of the image the broadband excitation of the deuterium nuclei included in the deuterated derivative of 2-amino-2-methylpropionic acid or 2-(N-methylamino)-2-methylpropionic acid and/or of its pharmaceutically acceptable salts, or of a mixture of deuterated derivatives of 2-amino-2-methylpropionic acid and/or 2-(N-methylamino)-2-methylpropionic acid and/or its pharmaceutically acceptable salts is used.

20. The method according to the claim 9, wherein the diagnostic agent is administered to a subject orally.

21. The method according to the claim 9, wherein the diagnostic agent is administered to a subject parenterally.

22. The method according to the claim 9, in which the magnetic resonance tomography and/or magnetic resonance spectroscopy on the deuterium nuclei is carried out in 20-360 minutes after the administration of the diagnostic agent.

23. The method according to the claim 9, wherein the diagnostic agent is administered to a subject in an amount corresponding to 0.25-1 g of deuterated derivative of 2-amino-2-methylpropionic acid or 2-(N-methylamino)-2-methylpropionic acid and/or its pharmaceutically acceptable salts, or mixtures deuterated derivatives of 2-amino-2-methylpropionic acid and/or 2-(N-methylamino)-2-methylpropionic acid and/or its pharmaceutically acceptable salt per 1 kg of body weight of a subject.