CLAIMS

1. An imaging agent comprising 2-deoxy-2-[^{18}F]fluoroglucaric acid (^{18}F-FGA), or a pharmaceutically-acceptable salt thereof, in which the imaging agent preferentially accumulates in a necrosis.

2. An imaging agent according to Claim 1, in which the imaging agent delivers a dosage of radiation in a range of from 1 mCi to 50 mCi.

3. A composition comprising an imaging agent according to Claim 1 or 2, the imaging agent disposed in a pharmaceutically-acceptable carrier, diluent, vehicle, or excipient.

4. A method of preparing a radiopharmaceutical for use in PET imaging, comprising:

combining a reaction initiator with a mixture comprising 2-deoxy-2-[^{18}F]fluoro-D-glucose (^{18}F-FDG), an oxidizing agent, an alkaline buffering agent, and a reaction accelerator to form a reaction mixture, in which the reaction initiator is selected from the group consisting of sodium hypochlorite (NaOCl) and calcium hypochlorite ($Ca(ClO)_2$ and the reaction accelerator is selected from the group consisting of sodium bromide (NaBr) and potassium bromide (KBr); and

reacting the reaction mixture for a duration of less than about 10 min causing conversion of substantially all of the ^{18}F-FDG into 2-deoxy-2-[^{18}F]fluoroglucaric acid (^{18}F-FGA).

5. A method according to Claim 4, in which the oxidizing agent is selected from the group consisting of 2,2,6,6-tetramethylpiperidine 1-oxyl (TEMPO), 4-hydroxy-TEMPO, TEMPO methacrylate, 4-Oxo-TEMPO, 4-amino-TEMPO, 4-acetamido-TEMPO, 4-carboxy-TEMPO, 4-hydroxy-TEMPO benzoate, 4-(2-Iodoacetamido)-TEMPO, 4-Maleimido-TEMPO, 4-Isothiocyanato-TEMPO, 4-(2-Bromoacetamido)-TEMPO, 4-methoxy-TEMPO, 4-Cyano-TEMPO, 4-amino-4-carboxy-TEMPO, 4-Phosphonooxy-TEMPO hydrate, 2,2,6,6-tetramethyl-4-(methylsulfonyloxy)-1-piperidinooxy, hydrogen peroxide, sodium hypochlorite, calcium hypochlorite, ozone, nitric acid, permanganate compounds, halogens, metal-catalyzed oxidation agents, gold nanoparticles, nanoparticles which mimic peroxidase activity-mimicking nanoparticles, glucose oxidase, and glucose-oxidizing enzymes or compounds.

6. A method according to Claim 4 or 5, in which the alkaline buffering agent has a buffering capacity in a pH range of 9 to 12.

7. A method according to Claim 4, 5 or 6, in which the reacting step occurs at a reaction temperature in a range of 0 °C to 25 °C.

8. A method according to any of Claims 4 to 7, comprising adding an acid to the reaction mixture after conversion of the ^{18}F-FDG into ^{18}F-FGA to change the pH of the reaction mixture to a pH in a range of 6.5 to 7.5.

9. A method according to any of Claims 4 to 8, in which the oxidizing agent is a free compound, or is linked to a bead, resin, or polymer.

10. A method according to any of Claims 4 to 9, in which the ^{18}F-FGA produced comprises an amount of radiation in a range of from 1 mCi to 50 mCi.

11. A kit for producing an imaging agent according to Claim 1 or 2, comprising: (1) an oxidizing agent, (2) a reaction initiator, (3) a reaction accelerator, and (4) an alkaline buffering agent, in which the reaction initiator is selected from the group consisting of sodium hypochlorite (NaOCl) and calcium hypochlorite ($Ca(ClO)_2$ and the reaction accelerator is selected from the group consisting of sodium bromide (NaBr) and potassium bromide (KBr); and instructions for combining a quantity of 2-deoxy-2-[^{18}F]fluoro-D-glucose (^{18}F-FDG) with the oxidizing agent, the reaction initiator, the reaction accelerator, and the buffering agent to produce the imaging agent, in which the imaging agent comprises ^{18}F-FGA.

12. A kit according to Claim 11, further comprising an acid able to neutralize the reaction mixture to a pH in a range of 6.5 to 7.5.

13. A kit according to Claim 11 or 12, in which the oxidizing agent is selected from the group consisting of 2,2,6,6-tetramethylpiperidine 1-oxyl (TEMPO), 4-hydroxy-TEMPO, TEMPO methacrylate, 4-Oxo-TEMPO, 4-amino-TEMPO, 4-acetamido-TEMPO, 4-carboxy-TEMPO, 4-hydroxy-TEMPO benzoate, 4-(2-Iodoacetamido)-TEMPO, 4-Maleimido-TEMPO, 4-Isothiocyanato-TEMPO, 4-(2-Bromoacetamido)-TEMPO, 4-methoxy-TEMPO, 4-Cyano-TEMPO, 4-amino-4-carboxy-TEMPO, 4-Phosphonooxy-TEMPO hydrate, 2,2,6,6-tetramethyl-4-(methylsulfonyloxy)-1-piperidinooxy, hydrogen peroxide, sodium hypochlorite, calcium hypochlorite, ozone, nitric acid, permanganate compounds, halogens, metal-catalyzed oxidation agents, gold nanoparticles, nanoparticles which mimic peroxidase activity-mimicking nanoparticles, glucose oxidase, and glucose-oxidizing enzymes or compounds.

14. A kit according to Claim 11, 12 or 13, in which the ^{18}F-FGA produced comprises an amount of radiation in a range of from 1 mCi to 50 mCi.

15. An imaging agent for use in a positron emission tomography (PET) imaging method, the imaging agent comprising the imaging agent according to Claim 1 or 2, the method comprising:

administering the imaging agent to a subject;

allowing the imaging agent to penetrate into a tissue of the subject, the tissue suspected to contain a necrosis; and

collecting a PET image of the tissue suspected to contain the necrosis.

CLAIMS

1. An imaging agent comprising 2-deoxy-2-[^{18}F]fluoroglucaric acid (^{18}F-FGA), or a pharmaceutically-acceptable salt thereof, in which the imaging agent preferentially accumulates in a necrosis.

2. A composition comprising an imaging agent according to Claim 1, the imaging agent disposed in a pharmaceutically-acceptable carrier, diluent, vehicle, or excipient.

3. A method of preparing a radiopharmaceutical for use in PET imaging, comprising:

combining a reaction initiator with a mixture comprising 2-deoxy-2-[^{18}F]fluoro-D-glucose (^{18}F-FDG), an oxidizing agent, an alkaline buffering agent, and a reaction accelerator to form a reaction mixture, in which the reaction initiator is selected from the group consisting of sodium hypochlorite (NaOCl) and calcium hypochlorite ($Ca(ClO)_2$) and the reaction accelerator is selected from the group consisting of sodium bromide (NaBr) and potassium bromide (KBr); and

reacting the reaction mixture for a duration of less than about 10 min and without the need to monitor and adjust pH, thereby causing conversion of the ^{18}F-FDG into 2-deoxy-2-[^{18}F]fluoroglucaric acid (^{18}F-FGA).

4. A method according to Claim 3, in which the oxidizing agent is selected from the group consisting of 2,2,6,6-tetramethylpiperidine 1-oxyl (TEMPO), 4-hydroxy-TEMPO, TEMPO methacrylate, 4-Oxo-TEMPO, 4-amino-TEMPO, 4-acetamido-TEMPO, 4-carboxy-TEMPO, 4-hydroxy-TEMPO benzoate, 4-(2-Iodoacetamido)-TEMPO, 4-Maleimido-TEMPO, 4-Isothiocyanato-TEMPO, 4-(2-Bromoacetamido)-TEMPO, 4-methoxy-TEMPO, 4-Cyano-TEMPO, 4-amino-4-carboxy-TEMPO, 4-Phosphonooxy-TEMPO hydrate, 2,2,6,6-tetramethyl-4-(methylsulfonyloxy)-1-piperidinooxy, hydrogen peroxide, sodium hypochlorite, calcium hypochlorite, ozone, nitric acid, permanganate compounds, halogens, metal-catalyzed oxidation agents, gold nanoparticles, nanoparticles which mimic peroxidase activity-mimicking nanoparticles, glucose oxidase, and glucose-oxidizing enzymes or compounds.

5. A method according to Claim 3 or 4, in which the alkaline buffering agent has a buffering capacity in a pH range of 9 to 12.

6. A method according to Claim 3, 4 or 5, in which the reacting step occurs at a reaction temperature in a range of 0 °C to 25 °C.

7. A method according to any of Claims 3 to 6, comprising adding an acid to the reaction mixture after conversion of the ^{18}F-FDG into ^{18}F-FGA to change the pH of the reaction mixture to a pH in a range of 6.5 to 7.5.

8. A method according to any of Claims 3 to 7, in which the oxidizing agent is a free compound, or is linked to a bead, resin, or polymer.

9. A method according to any of Claims 3 to 8, in which the ^{18}F-FGA produced comprises an amount of radiation in a range of from 1 mCi to 50 mCi.

10. A kit for producing an imaging agent according to Claim 1, comprising: (1) an oxidizing agent, (2) a reaction initiator, (3) a reaction accelerator, and (4) an alkaline buffering agent, in which the reaction initiator is selected from the group consisting of sodium hypochlorite (NaOCl) and calcium hypochlorite ($Ca(ClO)_2$ and the reaction accelerator is selected from the group consisting of sodium bromide (NaBr) and potassium bromide (KBr); and instructions for combining a quantity of 2-deoxy-2-[^{18}F]fluoro-D-glucose (^{18}F-FDG) with the oxidizing agent, the reaction initiator, the reaction accelerator, and the buffering agent to produce the imaging agent in less than about 10 min without the need to monitor and adjust pH, in which the imaging agent comprises ^{18}F-FGA.

11. A kit according to Claim 10, further comprising an acid able to neutralize the reaction mixture to a pH in a range of 6.5 to 7.5.

12. A kit according to Claim 10 or 11, in which the oxidizing agent is selected from the group consisting of 2,2,6,6-tetramethylpiperidine 1-oxyl (TEMPO), 4-hydroxy-TEMPO, TEMPO methacrylate, 4-Oxo-TEMPO, 4-amino-TEMPO, 4-acetamido-TEMPO, 4-carboxy-TEMPO, 4-hydroxy-TEMPO benzoate, 4-(2-Iodoacetamido)-TEMPO, 4-Maleimido-TEMPO, 4-Isothiocyanato-TEMPO, 4-(2-Bromoacetamido)-TEMPO, 4-methoxy-TEMPO, 4-Cyano-TEMPO, 4-amino-4-carboxy-TEMPO, 4-Phosphonooxy-TEMPO hydrate, 2,2,6,6-tetramethyl-4-(methylsulfonyloxy)-1-piperidinooxy, hydrogen peroxide, sodium hypochlorite, calcium hypochlorite, ozone, nitric acid, permanganate compounds, halogens, metal-catalyzed oxidation agents, gold nanoparticles, nanoparticles which mimic peroxidase activity-mimicking nanoparticles, glucose oxidase, and glucose-oxidizing enzymes or compounds.

13. A kit according to Claim 10, 11 or 12, in which the ^{18}F-FGA produced comprises an amount of radiation in a range of from 1 mCi to 50 mCi.

14. An imaging agent for use in a positron emission tomography (PET) imaging method, the imaging agent comprising the imaging agent according to Claim 1, the method comprising:

administering the imaging agent to a subject;

allowing the imaging agent to penetrate into a tissue of the subject, the tissue suspected to contain a necrosis; and

collecting a PET image of the tissue suspected to contain the necrosis.