

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
4 March 2004 (04.03.2004)

PCT

(10) International Publication Number
WO 2004/017814 A2

(51) International Patent Classification⁷: **A61B**

(21) International Application Number:
PCT/US2003/026236

(22) International Filing Date: 22 August 2003 (22.08.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/405,294 23 August 2002 (23.08.2002) US

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(81) Designated States (*national*): CA, US.

(84) Designated States (*regional*): European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: NOVEL METHOD AND COMPOSITION OF IDENTIFYING INFLAMMATION BY CAT SCAN

(57) Abstract: The present invention is directed toward a system to detect inflammation in tissue of a patient. A system for use with the present invention may comprise a source of a plurality of a nanoparticulate contrast agent, a scanner, a data store, and an analyzer. A method of the present invention is directed toward injecting a patient with a plurality of a nanoparticulate contrast agent and scanning the patient's body with computed tomography (CT). CT generated data is analyzed and used to assess the presence of inflammation in the patient's tissue. It is emphasized that this abstract is provided to comply with the rules requiring an abstract which will allow a searcher or other reader to quickly ascertain the subject matter of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims.



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TITLE: Novel Method and Composition Of Identifying Inflammation By CAT Scan

PRIORITY INFORMATION

[0001] This application claims the benefit of U.S. Provisional Application No. 60/405,294 filed on August 23, 2002.

FIELD OF INVENTION

[0002] The present invention relates generally to the field of coronary risk assessment. More particularly, the present invention relates to a system and method for detection of inflammation in live tissue using computed tomography, and, more particularly, to detection of vulnerable atherosclerotic plaque via a new encapsulated-radioactive contrast media.

BACKGROUND OF THE INVENTION

[0003] Atherosclerosis, formerly considered a bland lipid storage disease, actually involves an ongoing inflammatory response. Recent advances in basic science have established a fundamental role for inflammation in mediating all stages of this disease from initiation through progression and, ultimately, the thrombotic complications of atherosclerosis. These new findings provide important links between risk factors and the mechanisms of atherogenesis. Clinical studies have illustrated that this emerging biology of inflammation in atherosclerosis applies directly to human patients.

[0004] A screening test that would allow early identification of coronary artery disease in its asymptomatic stage may allow early, aggressive targeted risk factor reduction. While office-based risk factor assessment is currently the reference standard for prediction of cardiac risk, non-invasive imaging techniques and novel serum markers have the potential to

directly or indirectly measure and monitor atherosclerosis in asymptomatic individuals and to empirically identify appropriate candidates for aggressive primary prevention. These may be best used after global risk assessment with traditional risk factors, to identify persons at moderate risk (e.g., a ten year risk of 10% to 20%) for whom additional testing may resolve whether or not they are at high risk and deserving of aggressive intervention.

[0005] Several invasive and noninvasive imaging techniques are available to assess atherosclerotic vessels. Most of the standard techniques identify luminal diameter, stenosis, wall thickness, and plaque volume; however, none can characterize plaque composition and therefore identify the high-risk plaques. The emergence of noninvasive imaging techniques to identify and quantify atherosclerosis of the coronary arteries and coronary artery disease (CAD) risk has evolved over the past several decades. These noninvasive imaging modalities include: (1) carotid artery imaging, (2) echocardiography, (3) transthoracic Doppler imaging of the coronary artery flow, (4) stress echocardiography with perfusion, (5) renal artery and perfusion imaging, (6) electron-beam computed tomography (EBCT), (7) magnetic resonance imaging, and (8) ankle-brachial indices.

[0006] There is a need for a screening test that would allow early identification of coronary artery disease in its asymptomatic stage using a noninvasive screening tool.

SUMMARY OF THE INVENTION

[0007] The present invention is directed toward a system which may be used to detect inflammation in tissue of a patient.

[0008] In an embodiment, a system for accomplishing the detection may use a source of a plurality of a nanoparticulate contrast agent, a scanner, a data store, and an analyzer.

[0009] A method of the present invention is directed toward injecting a patient with a plurality of a nanoparticulate contrast agent and scanning the patient's body with computed

tomography (CT). CT generated data is analyzed and used to assess the presence of inflammation in the patient's tissue.

[0010] It is emphasized that this summary is not to be interpreted as limiting the scope of these inventions which are limited only by the claims herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Fig. 1 is a schematic diagram of a preferred embodiment of a system for coronary risk assessment;

[0012] Fig. 2 is a flowchart of a first preferred embodiment of a method of coronary risk assessment; and

[0013] Fig. 3 is a flowchart of a second preferred embodiment of a method of coronary risk assessment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0014] As used herein, that which is described as software may be equivalently implemented as hardware.

[0015] Referring now to Fig. 1, system 10 may be used for detecting inflammation in tissue, e.g. in patient 5. System 10 comprises source 50 of a plurality of a nanoparticulate contrast agent 52; scanner 20; data store 30; and analyzer 40.

[0016] In a preferred embodiment, scanner 20 is adapted to detect nanoparticulate contrast agent 52 present in tissue, e.g. in patient 5 and may comprise a computed tomography (CT) scanner.

[0017] Data store 30 is operatively coupled to scanner 20 and adapted to receive and store data generated by scanner 20. In one embodiment, data store 30 may comprise a persistent data store, such as. a magnetic medium, an electronic medium, an optical medium, an electro-optic medium, or the like, or a combination thereof, and/or a transient data store, e.g. random access memory (RAM).

[0018] Analyzer 40 is operatively coupled to data store 30 and comprises module 42 (not illustrated in the figures) which is adapted to identify an accumulation of nanoparticulate contrast agent 52 in patient 5 using data from scanner 20 stored in data store 30. Analyzer 40 may further comprise fluorometry module 43 (not illustrated in the figures) and/or fluorescence microscopy module 44 (not illustrated in the figures). Module 42, fluorometry module 43, and fluorescence microscopy module 44 may be hardware, software, or a combination of hardware and software.

[0019] Source 50 of a plurality of a nanoparticulate contrast agent 52 may be a source of plurality of a coated radiotracer nanoparticle, a source of a carbon tube nanoparticle, a source of a C60 (Buckey-ball) nanoparticle, a source of a liposome containing an encapsulated contrast medium, a source of a carbon nanoparticle containing a contrast medium, or the like, or a combination thereof.

[0020] These nanoparticles may further comprise a liposomal coated radiotracer nanoparticle, carbon, liposomal iohexol, a contrast agent encapsulated in calcium, or the like, or a combination thereof.

[0021] Contrast media may comprise iodine and/or calcium. The contrast medium may be encapsulated within a lipid bilayer and/or a liposome vesicle.

[0022] Referring now to **Fig. 2**, a first preferred method of detecting inflammation in tissue comprises injecting a plurality of nanoparticulate contrast agent 52 (illustrated in **Fig. 1**) into a lumen in the body of patient 5 (illustrated in **Fig. 1**) in which hemodynamic activity occurs, as illustrated in block 100 of **Fig. 2**; scanning a region of interest in the body of patient 5 using computed tomography (CT), as illustrated in block 110 of **Fig. 2**; storing CT generated data from the scanning in data store 30 (illustrated in **Fig. 1**), as illustrated in block 120 of **Fig. 2**; analyzing the stored data where the analyzing comprises detecting an accumulation of nanoparticulate contrast agent 52 (illustrated in **Fig. 1**) in patient 5, as

illustrated in block 130 of Fig. 2; and, from the analyzing, assessing the presence of inflammation in tissue in patient 5, as illustrated in block 140 of Fig. 2.

[0023] Referring now to **Fig. 3**, a second preferred method of detecting inflammation in tissue comprises performing a first scan of a region of interest in a body of patient 5 (illustrated in **Fig. 1**) using computed tomography (CT), as illustrated in block 200 of Fig. 3; storing CT generated data from the first scan, as illustrated in block 210 of Fig. 3; injecting a multiplicity of nanoparticulate contrast agent 52 into a lumen in the body of patient 5 wherein hemodynamic activity occurs, as illustrated in block 220 of Fig. 3; performing a second scan of the region of interest in the body of patient 5 using CT, as illustrated in block 230 of Fig. 3; storing CT generated data from the second scan, as illustrated in block 240 of Fig. 3; analyzing the stored data where such analyzing comprises detecting an accumulation of nanoparticulate contrast agent 52 in patient 5 and comparing the data from the first scan with the data from the second scan, as illustrated in block 250 of Fig. 3; and assessing the presence of inflammation in tissue in patient 5 from said analyzing, as illustrated in block 260 of Fig. 3.

[0024] It will be understood that various changes in the details, materials, and arrangements of the parts which have been described and illustrated above in order to explain the nature of this invention may be made by those skilled in the art without departing from the principle and scope of the invention as recited in the appended claims.

STATEMENT OF INDUSTRIAL USE

[0025] The present invention may be used for detection of inflammation in live tissue, e.g. in a human patient, using computed tomography, and, more particularly, to detection of vulnerable atherosclerotic plaque via a new encapsulated-radioactive contrast media.

CLAIMS:

What is claimed is:

1. A method of detecting inflammation in tissue, comprising:
 - a. injecting a plurality of a nanoparticulate contrast agent (52) into a lumen in a patient's body (5) wherein hemodynamic activity occurs;
 - b. scanning a region of interest in the patient's body (5) using computed tomography (CT);
 - c. storing CT generated data from said scanning in a data store (30);
 - d. analyzing said stored data, said analyzing comprising detecting the accumulation of the nanoparticulate contrast agent (52) in the patient (5); and
 - e. assessing the presence of inflammation in tissue in the patient (5) from said analyzing.
2. The method of claim 1, wherein said nanoparticulate contrast agent (52) is a liposome containing encapsulated contrast media.
3. The method of claim 2, wherein said contrast media is one of (i) iodine or (ii) calcium.
4. The method of claim 2, wherein said contrast media is encapsulated within the lipid bilayer.
5. The method of claim 2, wherein said contrast media is encapsulated within the liposome vesicle.

6. The method of claim 1, wherein said nanoparticulate contrast agent (52) is a carbon nanoparticle containing contrast media
7. The method of claim 6, wherein said contrast media is one of (i) iodine or (ii) calcium.
8. The method of claim 6, wherein said carbon nanoparticle is one of (i) a Buckyball (C-60) or (ii) a carbon nanotube.
9. A method of detecting inflammation in tissue, comprising:
 - a. performing a first scan of a region of interest in a patient's body (5) using computed tomography (CT);
 - b. storing CT generated data from said first scan in a data store;
 - c. injecting a multiplicity of a nanoparticulate contrast agent (52) into a lumen in the patient's body (5) wherein hemodynamic activity occurs;
 - d. performing a second scan of the region of interest in the patient's body (5) using CT;
 - e. storing CT generated data from said second scan in the data store;
 - f. analyzing said stored data, said analyzing comprising detecting an accumulation of the nanoparticulate contrast agent (52) in the patient (5) and comparing the data from said first scan with the data from the second scan; and
 - g. assessing the presence of inflammation in tissue in the patient (5) from said analyzing.

10. The method of claim 9, wherein said nanoparticulate contrast agent (52) is a liposome containing encapsulated contrast media.
11. The method of claim 10, wherein said contrast media is one of (i) iodine or (ii) calcium.
12. The method of claim 10, wherein said contrast media is encapsulated within the lipid bilayer.
13. The method of claim 10, wherein said contrast media is encapsulated within the liposome vesicle.
14. The method of claim 9, wherein said nanoparticulate contrast agent (52) is a carbon nanoparticle containing contrast media
15. The method of claim 14, wherein said contrast media is one of (i) iodine or (ii) calcium.
16. The method of claim 14, wherein said carbon nanoparticle is one of (i) a Buckyball (C-60) or (ii) a carbon nanotube.
17. A system for detecting inflammation in tissue, comprising:
 - a. a source (50) of a plurality of a nanoparticulate contrast agent (52);
 - b. a scanner (20) adapted to detect the nanoparticulate contrast agent (52) present in tissue;

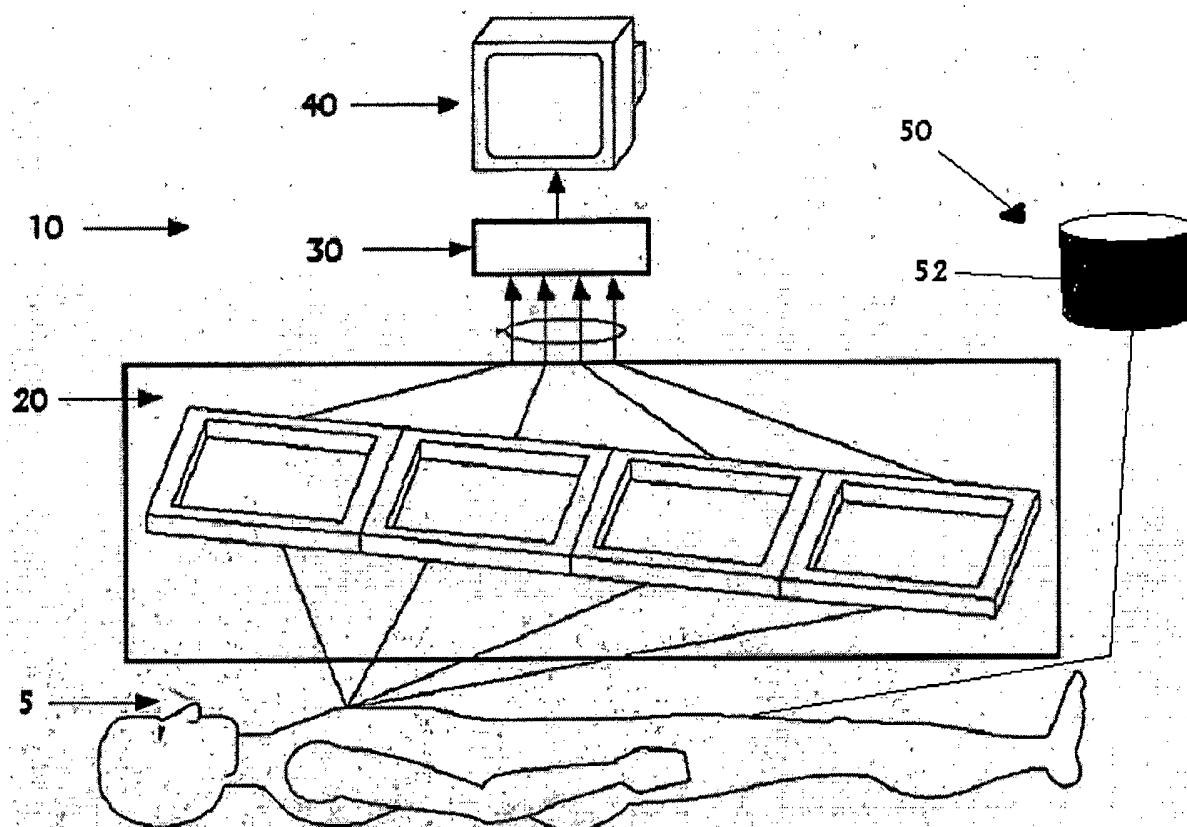
- c. a data store (30) operatively coupled to the scanner (20); and
- d. an analyzer (40) operatively coupled to the data store (30), the analyzer (40) comprising a module (42) adapted to identify an accumulation of the nanoparticulate contrast agent (52) in a patient (5) using data from the scanner (20) stored in the data store (30).

18. The system of claim 17, wherein the scanner (20) comprises a computed tomography (CT) scanner.

19. The system of claim 17, wherein the source (50) of a plurality of a nanoparticulate contrast agent (52) comprises at least one of (i) a source (50) of a plurality of a coated radiotracer nanoparticle, (ii) a source (50) of a nanocarbon tube nanoparticle, or (iii) a source (50) of a C60 (Buckey-ball) nanoparticle.

20. The system of claim 19, wherein the nanoparticle further comprises at least one of (i) liposomal coated radiotracer nanoparticle, (ii) carbon, (iii) liposomal iohexol, or (iv) a contrast agent (52) encapsulated in calcium.

21. The system of claim 17, wherein the analyzer (40) further comprises at least one of (i) a fluorometry module (43) or (ii) a fluorescence microscopy module (44).



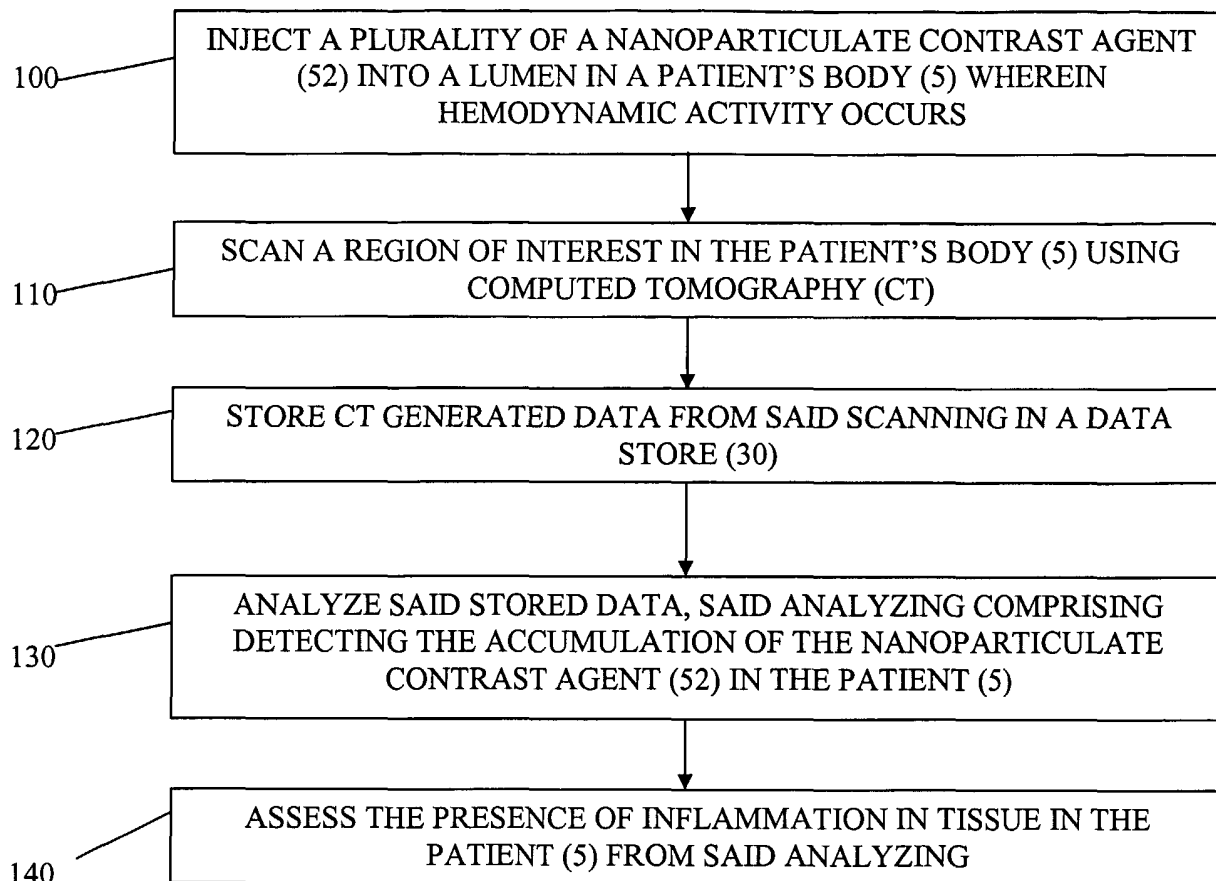


FIG. 2

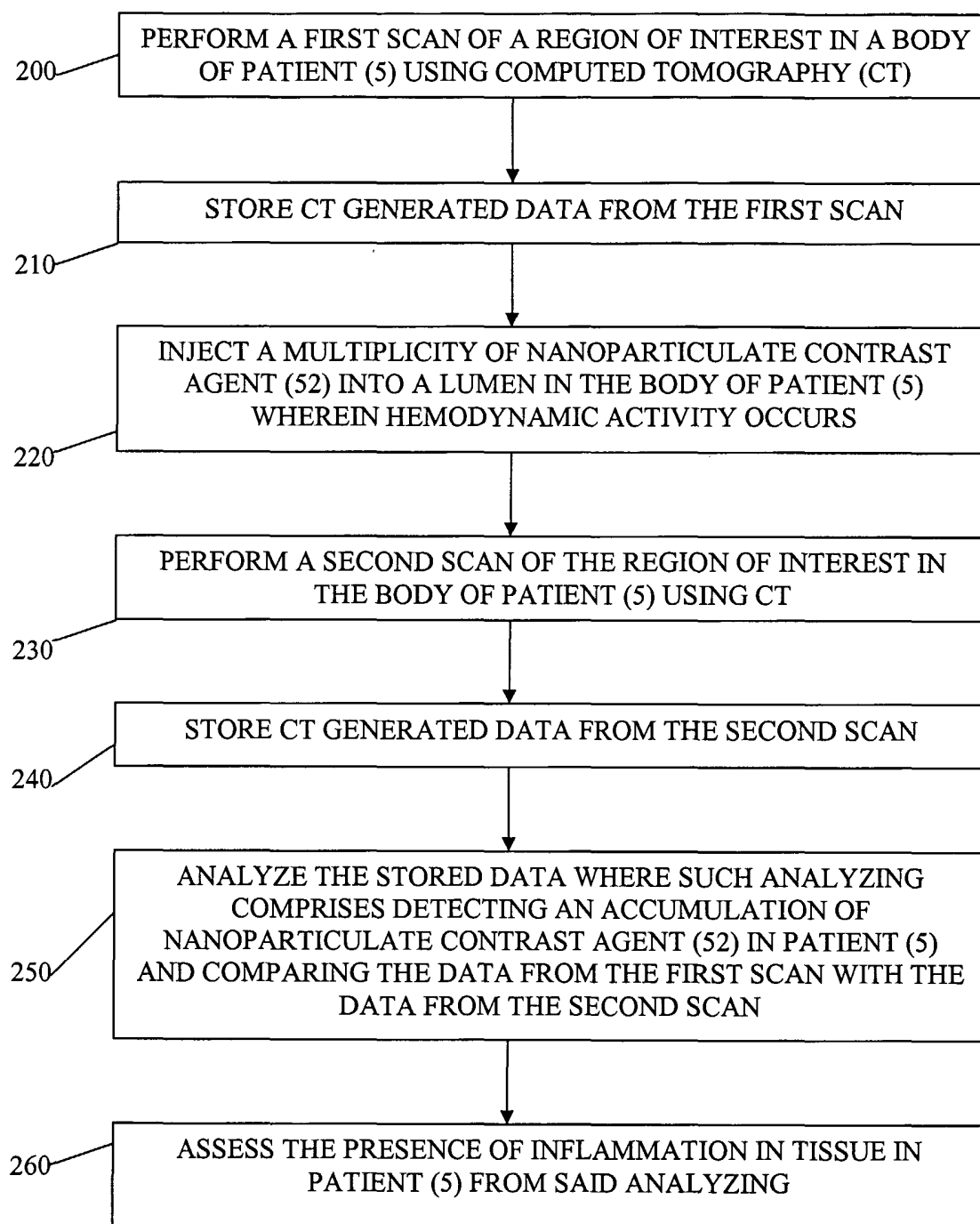


FIG. 3