

Claims

1. A method for determining the perivascular water index (PVWi) of a blood vessel, comprising
 - 5 (i) using data gathered from a computer tomography scan along a length of the vessel to determine the total volume of voxels of water within an attenuation window around the attenuation of water within the perivascular space a pre-determined distance from the outer wall of the vessel, and
 - (ii) correcting the total volume of the voxels of water for the volume of the
10 vessel by dividing the total volume of voxels of water determined in step (i) by the total perivascular volume.
2. A method according to claim 1, wherein the attenuation window around the attenuation of water is from -30 to +30 Hounsfield units (HU).
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3. A method according to claim 2, wherein the attenuation window around the attenuation of water is from -15 to +15 HU.
4. A method according to any preceding claim, wherein the pre-determined
20 distance from the outer wall of the vessel is a standard distance that is not equal to or related to the diameter or radius of the underlying vessel.
5. A method according to any of claims 1 to 3, wherein the pre-determined distance from the outer wall of the vessel is either a distance equal to the radius
25 or diameter of the underlying vessel or a distance that is representative of a dimension of the underlying vessel.
6. A method according to any preceding claim, wherein the data is gathered from a computerised tomography scan along a length of the right coronary
30 artery, left anterior descending artery, left circumflex artery, aorta, carotid arteries or femoral arteries.

7. The method according to claim 6, wherein the data is gathered from a computerised tomography scan along a 4cm length, starting 1cm distally to the origin of the right coronary artery.
- 5 8. The method according to any of claims 1 to 5, wherein the data is gathered from a computerised tomography scan along a length of the aorta.
9. Use of perivascular water index (PVWi) as a functional biomarker of vascular inflammation, wherein PVWi is defined according to the method of any
10 of claims 1 to 8.
10. Use of PVWi as a functional biomarker according to claim 9, wherein the biomarker is used to predict all-cause or cardiac mortality risk in a patient.
- 15 11. Use of PVWi as a functional biomarker according to claim 10, wherein PVWi is used in combination with additional functional and/or biomarkers of vascular inflammation.
12. Use of PVWi as a functional biomarker according to claim 11, wherein the
20 structural biomarkers of vascular inflammation include one or more of calcium index and fibrous plaque index, and/or wherein the additional functional biomarkers of vascular inflammation include one or more of the fat attenuation index of the perivascular adipose tissue (FAI_{PVAT}), fat attenuation index of the epicardial adipose tissue (FAI_{EPAT}) and volumetric perivascular characterisation
25 index (VPCI).
13. A method for predicting the mortality risk or risk of a patient suffering a cardiovascular event, said method comprising:
(a) using data gathered from a computer tomography (CT) scan along a length
30 of a blood vessel to determine:
(i) calcium index (Calcium-i); and/or
(ii) fibrous plaque index (FPi);

and at least one of

- (iii) fat attenuation index of the perivascular adipose tissue (FAI_{PVAT});
- (iv) perivascular water index ($PVWi$); and/or
- (v) fat attenuation index of the epicardial adipose tissue (FAI_{EpAT}); and

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(b) comparing each of the values determined in (a) to a pre-determined cut-off value or using the absolute value of each variable in order to generate an output value that indicates the patient's risk of suffering a cardiovascular event.

10 14. A method according to claim 13, both FAI_{PVAT} and $PVWi$ are determined in step (a).

15 15. A method according to claims 13 or 14, wherein the data is gathered from a computerised tomography scan along a length of the right coronary artery, left anterior descending artery, left circumflex artery, aorta, carotid arteries or femoral arteries.

20 16. The method according to claim 15 wherein the data is gathered from a computerised tomography scan along a 4 cm length, starting 1 cm distally to the origin of the right coronary artery.

17. The method according to claims 13 or 14, wherein the data is gathered from a computerised tomography scan along a length of the aorta.

25 18. The method according to any of claims 13 to 17, wherein step (a) further comprises using the data gathered from a computer tomography scan along a length of a blood vessel to determine (v) volumetric perivascular characterisation index ($VPCI$), and wherein the value of (v) is included in step (b) of claim 13.

30 19. The method according to any of claims 13 to 18, further comprising determining one or more of (vi) epicardial adipose tissue volume ($EpAT-vol$) and

(vii) fat attenuation index of the epicardial adipose tissue (FAI_{EpAT}) and wherein the value of (vi) and/or (vii) is included in step (b) of claim 13.

20. The method according to any of claims 13 to 19, further comprising
5 determining one or more of (viii) the age and (ix) gender of the patient and wherein the value of (viii) and/or (ix) is included in step (b) of claim 13.

21. The method according to any of claims 13 to 20, wherein coefficients for
10 each of (i) to (vii) are derived from Cox hazard or logistic regression models.

22. The method according to any of claims 13 to 20, wherein the cut-off
points for each of (i) to (vii) are derived from receiver operating characteristic
(ROC) curves.

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23. The method according to any of claims 13 to 22, wherein the output
value is a continuous single value function or a value that falls within one of
three discrete brackets corresponding to low, medium and high risk of a cardiac
20 event, cardiac death or all-cause mortality.

24. The method according to any of claims 13 to 23, wherein the method is
used to stratify patients according to their risk of all-cause or cardiac mortality.

25. The method according to any of claims 13 to 24, wherein the patient has
25 been diagnosed with vascular inflammation, or a condition known to be associated with vascular inflammation.

26. Use of the method according to any of claims 13 to 25 for non-invasive
30 monitoring of aortic aneurysms and/or carotid plaques, wherein said method does not include determining $EpAT$ volume or FAI_{EpAT} .