

indicates that the patient has cancer, wherein the control group comprises a patient suffering from pleural effusion without cancer, and wherein the cancer is selected from lung cancer, breast cancer, gastric cancer and squamous cell carcinoma.

[0009] In one example, there is provided a method of treating cancer in a patient suffering from pleural effusion, the method comprising: (i) measuring the concentration of the cancer biomarker of the present invention in a sample obtained from the patient; (ii) comparing the concentration of the cancer biomarker in (i) with the concentration of the same cancer biomarker in a sample obtained from a control group, wherein the control group comprises a patient suffering from pleural effusion without cancer; and (iii) administering to the patient at least one anti-cancer treatment, if there is an increased concentration of the cancer biomarker in (i) as compared to the control group; wherein the cancer is selected from lung cancer, breast cancer, gastric cancer and squamous cell carcinoma.

[0010] In one example, there is provided a cancer biomarker for the detection of cancer with EGFR mutation, wherein the biomarker is at least two selected from the group consisting of: fatty acid (20:5), fatty acid (22:5), fatty acid (18:1), fatty acid (18:3), phosphatidylcholine (38:8), phosphatidylcholine (40:8), phosphatidylcholine (41:6), phosphatidylethanolamine (P-36:5), phosphatidylcholine (36:5), phosphatidylcholine (P-36:5), fatty acid (22:4), fatty acid (23:0), phosphatidylethanolamine (38:4), triacylglycerol 54:8 and Gb3(42:2), and wherein the cancer is selected from lung cancer, breast cancer, gastric cancer and squamous cell carcinoma.

[0011] In another aspect, there is provided a method of determining whether a patient suffering from pleural effusion has cancer with EGFR mutation, the method comprising: (i) determining whether the patient has cancer, using the method of the present invention; (ii) measuring the concentration of a cancer biomarker for the detection of cancer with EGFR mutation in a sample obtained from the patient, wherein the cancer biomarker for the detection of cancer with EGFR mutation is at least two selected from the group consisting of: fatty acid (20:5), fatty acid (22:5), fatty acid (18:1), fatty acid (18:3), phosphatidylcholine (38:8), phosphatidylcholine (40:8), phosphatidylcholine (41:6), phosphatidylethanolamine (P-36:5), phosphatidylcholine (36:5), phosphatidylcholine (P-36:5), fatty acid (22:4), fatty acid (23:0), phosphatidylethanolamine (38:4), triacylglycerol 54:8 and Gb3(42:2); (iii) comparing the

concentration of the cancer biomarker in (ii) with the concentration of the same cancer biomarker in a sample obtained from a control group, wherein an increased concentration of the cancer biomarker in (ii) as compared to the control group indicates that the patient has EGFR mutation, wherein the control group comprises a patient suffering from cancer without
5 EGFR mutation, and wherein the cancer is selected from lung cancer, breast cancer, gastric cancer and squamous cell carcinoma.

[0012] In one example, there is provided a method of treating cancer in a patient with EGFR mutation, the method comprising: (i) measuring the concentration of the cancer biomarker of the present invention in a sample obtained from the patient; (ii) comparing the

Claims

1. A cancer biomarker for a patient suffering from pleural effusion, wherein the biomarker is at least two selected from the group consisting of: fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (20:1), fatty acid (18:2), fatty acid (18:1), fatty acid (16:1), fatty acid (20:5), fatty acid (22:4), fatty acid (22:5), fatty acid (20:4) and fatty acid (20:2), and wherein the cancer is selected from lung cancer, breast cancer, gastric cancer and squamous cell carcinoma.
2. The cancer biomarker of claim 1, wherein the biomarker is selected from the group consisting of: (1) fatty acid (22:6) and hydroxyl fatty acid (16:0); (2) fatty acid (22:6), hydroxyl fatty acid (16:0) and fatty acid (18:2); (3) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (18:2) and fatty acid (18:1); (4) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (18:2), fatty acid (18:1) and fatty acid (22:5); (5) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (18:2), fatty acid (18:1), fatty acid (22:5) and fatty acid (20:4); (6) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (18:2), fatty acid (18:1), fatty acid (22:5), fatty acid (20:4) and fatty acid (20:2); (7) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (18:2), fatty acid (18:1), fatty acid (22:5), fatty acid (20:4), fatty acid (20:2) and fatty acid (20:1); (8) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (18:2), fatty acid (18:1), fatty acid (22:5), fatty acid (20:4), fatty acid (20:2), fatty acid (20:1) and fatty acid (20:5); (9) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (18:2), fatty acid (18:1), fatty acid (22:5), fatty acid (20:4), fatty acid (20:2), fatty acid (20:1), fatty acid (20:5) and fatty acid (22:4); (10) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (18:2), fatty acid (18:1), fatty acid (22:5), fatty acid (20:4), fatty acid (20:2), fatty acid (20:1), fatty acid (20:5), fatty acid (22:4) and fatty acid (16:1); (11) fatty acid (22:6), hydroxyl fatty acid (16:0) and fatty acid (20:1); (12) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (20:1) and fatty acid (18:2); (13) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (20:1), fatty acid (18:2) and fatty acid (18:1); (14) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (20:1), fatty acid (18:2), fatty acid (18:1) and fatty acid (16:1); (15) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (20:1), fatty acid (18:2), fatty acid (18:1), fatty acid (16:1) and fatty acid (20:5); (16) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (20:1), fatty acid (18:2), fatty acid (18:1), fatty acid (16:1), fatty acid (20:5) and fatty acid

(22:4); (17) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (20:1), fatty acid (18:2), fatty acid (18:1), fatty acid (16:1), fatty acid (20:5), fatty acid (22:4) and fatty acid (22:5); and (18) fatty acid (22:6), hydroxyl fatty acid (16:0), fatty acid (20:1), fatty acid (18:2), fatty acid (18:1), fatty acid (16:1), fatty acid (20:5), fatty acid (22:4), fatty acid (22:5) and fatty acid (20:4).

3. The cancer biomarker of claim 1, further comprising FA (23:0) and/or FA (18:3).

4. The cancer biomarker of claim 1 or 3, further comprising at least one selected from the group consisting of: Gb3 (42:2), lysophosphatidylethanolamine (P-18:0), phosphatidylcholine (o-36:1), lysophosphatidylcholine (22:6), phosphatidylethanolamine (38:4), Gb3(34:1), AcylCar18:2, sphingomyelin (42:2) and GalCer(40:1)/GlcCer(40:1).

5. The cancer biomarker of claim 4, wherein the biomarker is selected from the group consisting of: (1) fatty acid (22:6), fatty acid (22:5) and fatty acid (23:0); (2) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0) and Gb3(42:2); (3) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0), Gb3(42:2) and fatty acid (18:2); (4) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0), Gb3(42:2), fatty acid (18:2) and hydroxyl fatty acid (16:0); (5) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0), Gb3(42:2), fatty acid (18:2), hydroxyl fatty acid (16:0) and lysophosphatidylethanolamine (P-18:0); (6) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0), Gb3(42:2), fatty acid (18:2), hydroxyl fatty acid (16:0), lysophosphatidylethanolamine (P-18:0) and phosphatidylcholine (o-36:1); (7) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0), Gb3(42:2), fatty acid (18:2), hydroxyl fatty acid (16:0), lysophosphatidylethanolamine (P-18:0), phosphatidylcholine (o-36:1) and lysophosphatidylcholine (22:6); (8) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0), Gb3(42:2), fatty acid (18:2), hydroxyl fatty acid (16:0), lysophosphatidylethanolamine (P-18:0), phosphatidylcholine (o-36:1), lysophosphatidylcholine (22:6) and phosphatidylethanolamine (38:4); (9) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0), Gb3(42:2), fatty acid (18:2), hydroxyl fatty acid (16:0), lysophosphatidylethanolamine (P-18:0), phosphatidylcholine (o-36:1), lysophosphatidylcholine (22:6), phosphatidylethanolamine (38:4) and fatty acid (18:3); (10) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0), Gb3(42:2), fatty acid (18:2), hydroxyl fatty acid (16:0),

lysophosphatidylethanolamine (P-18:0), phosphatidylcholine (o-36:1),
 lysophosphatidylcholine (22:6), phosphatidylethanolamine (38:4), fatty acid (18:3) and
 Gb3(34:1); (11) fatty acid (22:6), fatty acid (22:5), fatty acid (23:0), Gb3(42:2), fatty acid
 (18:2), hydroxyl fatty acid (16:0), lysophosphatidylethanolamine (P-18:0),
 5 phosphatidylcholine (o-36:1), lysophosphatidylcholine (22:6), phosphatidylethanolamine
 (38:4), fatty acid (18:3), Gb3(34:1) and AcylCar (18:2); (12) fatty acid (22:6), fatty acid
 (22:5), fatty acid (23:0), Gb3(42:2), fatty acid (18:2), hydroxyl fatty acid (16:0),
 lysophosphatidylethanolamine (P-18:0), phosphatidylcholine (o-36:1),
 lysophosphatidylcholine (22:6), phosphatidylethanolamine (38:4), fatty acid (18:3),
 10 Gb3(34:1), AcylCar (18:2) and sphingomyelin (42:2); and (13) fatty acid (22:6), fatty acid
 (22:5), fatty acid (23:0), Gb3(42:2), fatty acid (18:2), hydroxyl fatty acid (16:0),
 lysophosphatidylethanolamine (P-18:0), phosphatidylcholine (o-36:1),
 lysophosphatidylcholine (22:6), phosphatidylethanolamine (38:4), fatty acid (18:3),
 Gb3(34:1), AcylCar (18:2), sphingomyelin (42:2) and GalCer(40:1)/GlcCer(40:1).

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6. The cancer biomarker of claim 5, wherein the biomarker comprises fatty acid (22:6),
 fatty acid (22:5), fatty acid (23:0) and Gb3(42:2).

7. A method of determining whether a patient suffering from pleural effusion has cancer,
 20 the method comprising:

(i) measuring the concentration of the cancer biomarker of any one of the preceding
 claims in a sample obtained from the patient;

(ii) comparing the concentration of the cancer biomarker in (i) with the concentration
 of the same cancer biomarker in a sample obtained from a control group,

25 wherein an increased concentration of the cancer biomarker in (i) as compared to the
 control group indicates that the patient has cancer,

wherein the control group comprises a patient suffering from pleural effusion without
 cancer, and

30 wherein the cancer is selected from lung cancer, breast cancer, gastric cancer and
 squamous cell carcinoma.

8. A method of determining whether a patient suffering from pleural effusion has cancer with EGFR mutation, the method comprising:

(i) determining whether the patient has cancer, using the method of claim 7;

(ii) measuring the concentration of a cancer biomarker for the detection of cancer with

5 EGFR mutation in a sample obtained from the patient, wherein the cancer biomarker for the detection of cancer with EGFR mutation is at least two selected from the group consisting of: fatty acid (20:5), fatty acid (22:5), fatty acid (18:1), fatty acid (18:3), phosphatidylcholine (38:8), phosphatidylcholine (40:8), phosphatidylcholine (41:6), phosphatidylethanolamine (P-36:5), phosphatidylcholine (36:5), phosphatidylcholine (P-36:5), fatty acid (22:4), fatty acid
10 (23:0), phosphatidylethanolamine (38:4), triacylglycerol 54:8 and Gb3(42:2);

(iii) comparing the concentration of the cancer biomarker in (ii) with the concentration of the same cancer biomarker in a sample obtained from a control group,

wherein an increased concentration of the cancer biomarker in (ii) as compared to the control group indicates that the patient has EGFR mutation,

15 wherein the control group comprises a patient suffering from cancer without EGFR mutation, and

wherein the cancer is selected from lung cancer, breast cancer, gastric cancer and squamous cell carcinoma.

20 9. The method of claim 8, wherein the cancer biomarker for the detection of cancer with EGFR mutation is selected from the group consisting of: (1) phosphatidylcholine (41:6) and fatty acid (22:5); (2) phosphatidylcholine (41:6), fatty acid (22:5) and fatty acid (23:0); (3) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0) and fatty acid (22:4); (4) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4) and
25 phosphatidylethanolamine (38:4); (5) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4) and Gb3(42:2); (6) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4), Gb3(42:2) and fatty acid (20:5); (7) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4),
30 Gb3(42:2), fatty acid (20:5) and fatty acid (18:1); (8) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4), Gb3(42:2), fatty acid (20:5), fatty acid (18:1) and phosphatidylcholine (P-36:5); (9) phosphatidylcholine

(41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4), Gb3(42:2), fatty acid (20:5), fatty acid (18:1), phosphatidylcholine (P-36:5) and fatty acid (18:3); (10) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4), Gb3(42:2), fatty acid (20:5), fatty acid (18:1),
5 phosphatidylcholine (P-36:5), fatty acid (18:3) and phosphatidylethanolamine (P-36:5); (11) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4), Gb3(42:2), fatty acid (20:5), fatty acid (18:1), phosphatidylcholine (P-36:5), fatty acid (18:3), phosphatidylethanolamine (P-36:5) and phosphatidylcholine (38:8); (12) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid
10 (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4), Gb3(42:2), fatty acid (20:5), fatty acid (18:1), phosphatidylcholine (P-36:5), fatty acid (18:3), phosphatidylethanolamine (P-36:5), phosphatidylcholine (38:8) and phosphatidylcholine (40:8); (13) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4), Gb3(42:2), fatty acid (20:5), fatty acid (18:1), phosphatidylcholine (P-36:5), fatty acid (18:3),
15 phosphatidylethanolamine (P-36:5), phosphatidylcholine (38:8), phosphatidylcholine (40:8) and triacylglycerol (54:8); and (14) phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4), Gb3(42:2), fatty acid (20:5), fatty acid (18:1), phosphatidylcholine (P-36:5), fatty acid (18:3), phosphatidylethanolamine (P-36:5), phosphatidylcholine (38:8), phosphatidylcholine (40:8), triacylglycerol (54:8) and
20 phosphatidylcholine (36:5).

10. The method of claim 8, wherein the cancer biomarker for the detection of cancer with EGFR mutation further comprises at least one selected from the group consisting of: fatty acid (20:3), fatty acid (20:4), fatty acid (22:6), lysophosphatidylethanolamine (P-16:0),
25 phosphatidylethanolamine (P-38:5), fatty acid (16:2) and phosphatidylcholine (P-32:1).

11. The method of claim 9, wherein the cancer biomarker for the detection of cancer with EGFR mutation comprises phosphatidylcholine (41:6), fatty acid (22:5), fatty acid (23:0), fatty acid (22:4), phosphatidylethanolamine (38:4), Gb3(42:2) and fatty acid (20:5).

12. The biomarker of any one of claims 1 to 6, or the method of any one of claims 7 to 11, wherein the cancer is lung cancer.
13. The biomarker or method of claim 12, wherein the lung cancer is non-small cell lung
5 cancer.
14. The biomarker or method of claim 13, wherein the non-small cell lung cancer is non-small cell lung adenocarcinoma.
- 10 15. The method of any one of claims 7 to 14, wherein the concentration of the biomarker is measured by targeted liquid chromatography mass spectrometry.
16. The method of any one of claims 7 to 15, wherein the sample is a liquid sample.
- 15 17. The method of claim 16, wherein the liquid sample comprises pleural fluid.