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(54) **METHOD FOR DETECTION OF IDIOPATHIC INTERSTITIAL PNEUMONIA**

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USPC **435/4**; 435/6.1; 435/7.1; 436/501

(58) **Field of Classification Search** None
See application file for complete search history.

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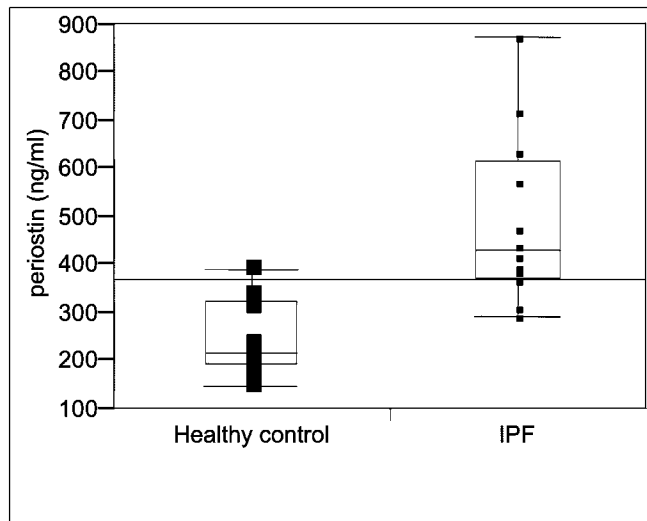
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(57) **ABSTRACT**

The present invention provides a method for detecting idiopathic interstitial pneumonia, which comprises measuring the expression level of a periostin gene or the amount of a periostin protein in a biological sample. Thereby, a method for detecting idiopathic interstitial pneumonia using a marker is provided.

8 Claims, 2 Drawing Sheets
(1 of 2 Drawing Sheet(s) Filed in Color)



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Fig. 1

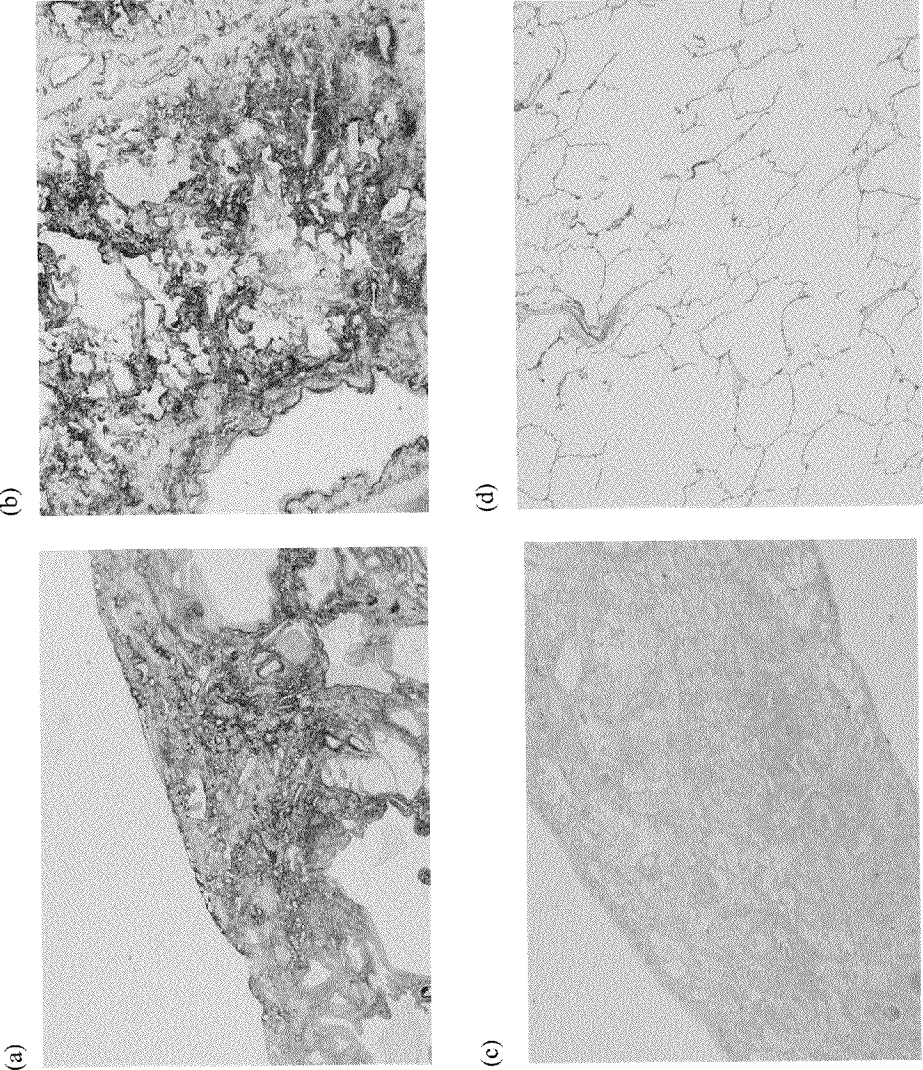
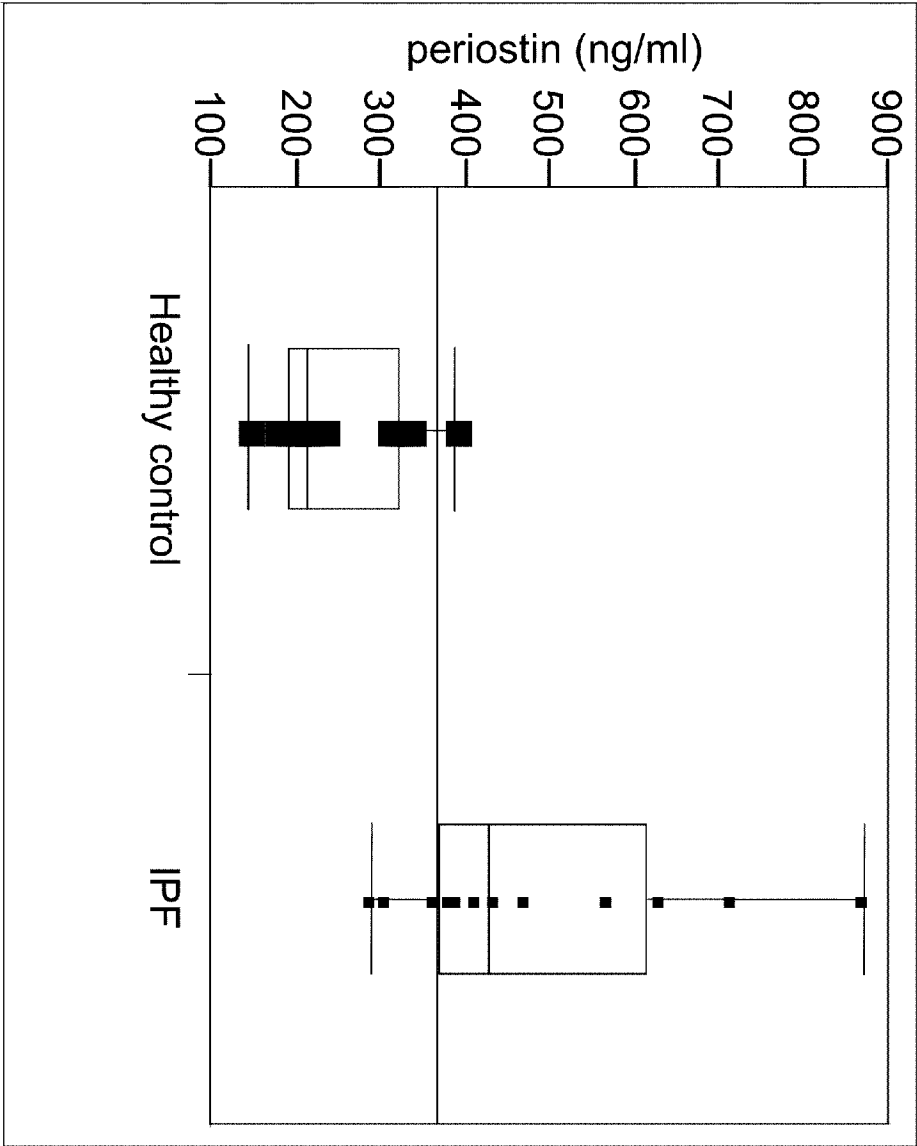


Fig. 2



METHOD FOR DETECTION OF IDIOPATHIC INTERSTITIAL PNEUMONIA

TECHNICAL FIELD

The present invention relates to a method for detecting idiopathic interstitial pneumonia, a method for screening for a preventive and/or therapeutic agent for idiopathic interstitial pneumonia, and a kit used for these methods.

BACKGROUND ART

Idiopathic interstitial pneumonia (IIP) is a cryptogenic disease characterized by the fibrosis of lung tissues. It is extremely difficult to predict the onset and progression of this disease.

According to histological classification, idiopathic interstitial pneumonia is classified into several types of disease, such as idiopathic pulmonary fibrosis (IPF) (or also referred to as usual interstitial pneumonia (UIP)) and nonspecific interstitial pneumonia (NSIP). IPF/UIP patients and NSIP patients account for 80% to 90% of all idiopathic interstitial pneumonia patients. NSIP is further classified into fibrotic NSIP and cellular NSIP. At present, there are no effective methods for a medical treatment of idiopathic interstitial pneumonia. Idiopathic interstitial pneumonia has a poor prognosis, and the median survival period of this disease is 2 to 4 years after the diagnosis of the disease. On the other hand, the prognosis of NSIP is better than those of IPF/UIP. Among others, the prognosis of cellular NSIP is much better than that of fibrotic NSIP. Thus, since the prognosis of patients with idiopathic interstitial pneumonia is different depending on the type of the disease, it is important to determine the type of idiopathic interstitial pneumonia in order to predict the prognosis of the patient with this disease.

The diagnosis of idiopathic interstitial pneumonia has been mainly made by radiography, an image diagnosis such as CT, a physiological pulmonary function test, etc. The definitive diagnosis has been made by a histological diagnosis involving the biopsy of lung tissues. However, the diagnostic accuracy of such image diagnosis is not as high as that of the histological diagnosis, and further, the image diagnosis requires high skilled, specialized diagnostic techniques. Furthermore, it is difficult for such image diagnosis to perform a quantitative diagnosis.

Under the aforementioned circumstances, it has been desired to develop a noninvasive diagnosis in addition to such an image diagnosis.

Document 1 describes that allergic disease is examined using the expression level of a periostin gene as an indicator.

Document 2 describes that periostin (osteoblast-specific factor 2) is generated in fibroblasts as a result of response to stimulation with IL-4 or IL-13, and that such periostin may be associated with the pulmonary fibrosis of patients with bronchial asthma.

(Documents)

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DISCLOSURE OF THE INVENTION

Under such circumstances, it has been desired to develop a method for detecting idiopathic interstitial pneumonia using a marker, and the like.

The present inventors have conducted intensive studies directed towards achieving the aforementioned object. As a

result, the inventors have found that the expression level of a periostin gene or the amount of a periostin protein is high in biological samples derived from patients with idiopathic interstitial pneumonia, and that idiopathic interstitial pneumonia can be detected using periostin as a marker. Based on these findings, the inventors have completed the present invention.

Specifically, the present invention provides a method for detecting or diagnosing idiopathic interstitial pneumonia, a method for screening for a preventive and/or therapeutic agent for idiopathic interstitial pneumonia, and a kit used for these methods, as described below.

- (1) A method for detecting or diagnosing idiopathic interstitial pneumonia, which comprises measuring the expression level of a periostin gene or the amount of a periostin protein in a biological sample.
- (2) The method according to (1) above, wherein the idiopathic interstitial pneumonia is idiopathic pulmonary fibrosis or nonspecific interstitial pneumonia.
- (3) The method according to (2) above, wherein the nonspecific interstitial pneumonia is fibrotic nonspecific interstitial pneumonia (fibrotic NSIP).
- (4) The method according to any one of (1) to (3) above, wherein the measurement is carried out by an immunoassay.
- (5) The method according to any one of (1) to (4) above, wherein the biological sample is lung tissues and/or blood.
- (6) The method according to any one of (1) to (5) above, which comprises comparing (i) the expression level of a periostin gene or the amount of a periostin protein in a biological sample derived from a subject, with (ii) the expression level of a periostin gene or the amount of a periostin protein in normal cells.
- (7) The method according to (6) above, which comprises determining that the subject has or is suspected to have idiopathic interstitial pneumonia, when (i) the expression level of a periostin gene or the amount of a periostin protein in the biological sample derived from the subject is higher than (ii) the expression level of a periostin gene or the amount of a periostin protein in the normal cells.
- (8) A method for screening for a preventive and/or therapeutic agent for idiopathic interstitial pneumonia, which comprises measuring the expression level of a periostin gene or the amount of a periostin protein, in a case in which cells having ability to produce periostin have been cultured in the presence of a candidate substance.
- (9) The method according to (8) above, wherein the idiopathic interstitial pneumonia is idiopathic pulmonary fibrosis or nonspecific interstitial pneumonia.
- (10) The method according to (9) above, wherein the nonspecific interstitial pneumonia is fibrotic nonspecific interstitial pneumonia (fibrotic NSIP).
- (11) The method according to any one of (8) to (10) above, wherein the measurement is carried out by an immunoassay.
- (12) The method according to any one of (8) to (11) above, wherein the biological sample is lung tissues and/or blood.
- (13) The method according to any one of (8) to (12) above, which comprises comparing (i) the expression level of a periostin gene or the amount of a periostin protein in a case in which cells having ability to produce periostin have been cultured in the presence of a candidate substance, with (ii) the expression level of a periostin gene or the amount of a periostin protein in a case in which cells having ability to produce periostin have been cultured in the absence of a candidate substance.

- (14) The method according to (13) above, which comprises selecting a candidate substance, when (i) the expression level of a periostin gene or the amount of a periostin protein in a case in which cells having ability to produce periostin have been cultured in the presence of the candidate substance is lower than (ii) the expression level of a periostin gene or the amount of a periostin protein in a case in which cells having ability to produce periostin have been cultured in the absence of the candidate substance.
- (15) A kit for detecting idiopathic interstitial pneumonia, which comprises a polynucleotide having the nucleotide sequence of a periostin gene, or a polynucleotide with a length of at least 21 nucleotides, which has a nucleotide sequence complementary to a complementary strand thereof
- (16) A kit for detecting idiopathic interstitial pneumonia, which comprises an antibody that recognizes a peptide having the amino acid sequence of a periostin protein.
- (16a) The kit according to (15) or (16) above, wherein the idiopathic interstitial pneumonia is idiopathic pulmonary fibrosis or nonspecific interstitial pneumonia.
- (16b) The kit according to (16a) above, wherein the nonspecific interstitial pneumonia is fibrotic nonspecific interstitial pneumonia (fibrotic NSIP).
- (17) A kit for screening for a preventive and/or therapeutic agent for idiopathic interstitial pneumonia, which comprises cells having ability to produce periostin.
- (17a) The kit according to (17) above, wherein the idiopathic interstitial pneumonia is idiopathic pulmonary fibrosis or nonspecific interstitial pneumonia.
- (17b) The kit according to (17a) above, wherein the nonspecific interstitial pneumonia is fibrotic nonspecific interstitial pneumonia (fibrotic NSIP).

According to the present invention, a method for detecting idiopathic interstitial pneumonia using a novel marker, and the like, are provided. In a preferred embodiment of the present invention, the invention is advantageous in that, for example, the detection results can be used to assist the definitive diagnosis of idiopathic interstitial pneumonia.

The patent or application file contains at least one color drawing. Copies of this patent or patent application publication with color drawing will be provided by the USPTO upon request and payment of the necessary fee.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 includes photographs showing the results obtained by histoimmunostaining of periostin in lung tissues. (a) IPF/UIP, (b) fibrotic NSIP, (c) cellular NSIP, and (d) a healthy control.

FIG. 2 is a graph showing the results obtained by the ELISA measurement of a blood periostin level.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention will be described in detail below.

It is to be noted that all publications cited in the present specification, which include prior art documents and patent documents such as laid-open application publications and patent publications, are incorporated herein by reference in their entirety. The present specification includes the contents as disclosed in the claims, specification and drawings of Japanese Patent Application No. 2008-147822, which is a priority document of the present application.

1. Summary of the Present Invention

The present invention relates to a method for detecting or diagnosing idiopathic interstitial pneumonia, which comprises measuring the expression level of a periostin gene or the amount of a periostin protein in a biological sample.

The present inventors have conducted intensive studies directed towards obtaining a marker that can be used for the detection of idiopathic interstitial pneumonia. As a result, the inventors have found that the expression level of a periostin gene or the amount of a periostin protein is high in the lung tissues, blood and the like of patients suffering from idiopathic interstitial pneumonia.

Specifically, the amount of a periostin protein in lung tissues derived from patients suffering from idiopathic interstitial pneumonia was measured by a histological staining method. As a result, the amount of a periostin protein was high in all of 23 IPF/UIP patients and 23 fibrotic NSIP patients (FIGS. 1(a) and 1(b)). The amount of a periostin protein was extremely low in 4 cellular NSIP patients (FIG. 1(c)). On the other hand, the amount of a periostin protein was extremely low in all of the normal lung tissues of 6 persons used as a control group (FIG. 1(d)).

Moreover, the amount of a periostin protein in blood collected from idiopathic interstitial pneumonia patients was measured by an immunoassay. A comparison was made between the results of 13 IPF/UIP patients and the results of 12 normal persons. As a result, it was found that there was a significant difference between the two groups and that the amount of a periostin protein was significantly increased in the blood of the IPF/UIP patients (FIG. 2).

As stated above, the expression level of a periostin gene or the amount of a periostin protein becomes high in tissues derived from patients with idiopathic interstitial pneumonia. Based on these results, the present inventors have found that periostin is useful as a marker for detecting idiopathic interstitial pneumonia.

Furthermore, the present invention also provides a method for screening for a preventive and/or therapeutic agent for idiopathic interstitial pneumonia, which comprises measuring the expression level of a periostin gene or the amount of a periostin protein, in a case in which cells having ability to produce periostin have been cultured in the presence of a candidate substance.

As described above, the expression level of a periostin gene is increased in tissues derived from patients with idiopathic interstitial pneumonia, and the periostin protein level becomes high in tissues derived from the patients. Accordingly, a compound that decreases the expression level of the periostin gene or the amount of the periostin protein when it is administered to the patient, or a salt thereof; namely, a compound that inhibits the aforementioned expression, or a salt thereof (e.g. a peptide, a protein, a synthetic compound, an anti-periostin antibody, or a salt thereof), can be used as a preventive and/or therapeutic agent for idiopathic interstitial pneumonia.

Further, the present invention also provides a kit used for the above-described method for detecting or diagnosing idiopathic interstitial pneumonia or the above-described method for screening for a preventive and/or therapeutic agent for idiopathic interstitial pneumonia.

2. Periostin

Periostin is an approximately 90 kDa protein, which is also referred to as "osteoblast-specific factor 2" (OSF2os; Horiuchi K, Amizuka N, Takeshita S, Takamatsu H, Katsuura M, Ozawa H, Toyama Y, Bonewald L F, Kudo A.; Identification and characterization of a novel protein, periostin, with restricted expression to periosteum and periodontal ligament and increased expression by transforming growth factor beta.

J Bone Miner Res. July 1999; 14(7): 1239-49.). It has been known that periostin has several transcripts, which can be distinguished from one another in terms of the length on the C-terminal side caused by alternative splicing. Herein, the DNA sequence of a transcript containing all exons of a human periostin gene is shown in SEQ ID NO: 1 (Accession No. D13666). In addition, examples of the DNA sequences of other splicing variants of human periostin are shown in SEQ ID NOS: 3 and 5 (Accession Nos. AY918092 and AY140646, respectively). Moreover, the amino acid sequences of periostins are shown respectively in SEQ ID NOS: 2, 4 and 6 which are encoded by the corresponding polynucleotides shown in SEQ ID NOS: 1, 3 and 5.

In a preferred embodiment of the present invention, the expression level of a periostin gene or the amount of a periostin protein, which contains a variant derived from the amino acid sequence shown in SEQ ID NO: 2 (for example, periostin consisting of the amino acid sequence shown in SEQ ID NO: 2, 4, or 6), is measured.

3. The Method of the Present Invention for Detecting or Diagnosing Idiopathic Interstitial Pneumonia

The expression level of a periostin gene or the amount of a periostin protein is increased in tissues derived from a patient with idiopathic interstitial pneumonia. Thus, periostin in a biological sample derived from a subject can be used as a marker for detecting or diagnosing idiopathic interstitial pneumonia. Specifically, the present invention provides a method for detecting idiopathic interstitial pneumonia, which comprises measuring the expression level of a periostin gene or the amount of a periostin protein in a biological sample. More specifically, (i) the expression level of a periostin gene or the amount of a periostin protein in a biological sample derived from a subject is compared with (ii) the expression level of a periostin gene or the amount of a periostin protein in normal cells, for example. That is, the amount of a periostin protein or the level of mRNA encoding periostin is measured, and the obtained values are then compared. Examples of a biological sample that can be used for the measurement of the expression level or the protein amount include lung tissues, blood, sputum, an exhaled breath condensate and a bronchoalveolar lavage fluid, which are derived from a subject, and a bronchial lining fluid collected using a bronchoscope. Preferably, a subject-derived lung tissue or blood is used. Methods for collecting lung tissues, blood, sputum, an exhaled breath condensate and a bronchoalveolar lavage fluid, and a method for collecting a bronchial lining fluid using a bronchoscope, are known. Normal cells mean cells derived from a person who is not affected with idiopathic interstitial pneumonia, for example. When the biological sample is lung tissue, sputum or like, it is preferable, for example, to prepare a lysate from the biological sample, or to extract mRNA from the biological sample, in order to use it for the measurement of the expression level or the protein amount. Preparation of a lysate and extraction of mRNA can be carried out by known methods, and commercially available kits are used, for example. When the biological sample is a liquid sample such as blood or a bronchoalveolar lavage fluid, it is diluted with a buffer or the like, and it is then preferably used to measure the level of mRNA encoding periostin, for example. The amount of a periostin protein can be measured by, for example, an immunoassay or the like. Preferably, the amount of a periostin protein can be measured by an immunoassay. Examples of such an immunoassay include a radioimmunoassay (RIA), a fluorescent immunoassay (FIA), a luminescent immunoassay, an enzyme immunoassay (e.g. Enzyme Immunoassay (EIA) and Enzyme-linked Immunosorbent assay (ELISA)), and a Western blot method. Examples of a radioactive sub-

stance that can be used for labeling in RIA include ^{125}I , ^{131}I , ^{14}C , ^3H , ^{35}S and ^{32}P . Examples of a fluorescent substance that can be used for labeling in FIA include fluorescent substances such as Eu (europium), FITC, TMRITC, Cy3, PE and Texas-Red. Examples of a luminescent substance that can be used for labeling in a luminescent immunoassay include luminol, luminol derivatives, luciferin and lucigenin. Examples of an enzyme that can be used for labeling in an enzyme immunoassay include horseradish peroxidase (HRP), alkaline phosphatase (ALP) and glucose oxidase (GO). Furthermore, a biotin-avidin system can also be used for the binding of an antibody or an antigen with these labeling substances. The measurement of an amount of mRNA can be carried out by a known method, for example, using a polynucleotide having the nucleotide sequence of a periostin gene or a portion thereof. More specifically, for example, the measurement can be carried out using a DNA chip, on which a polynucleotide having the nucleotide sequence shown in SEQ ID NO: 1, 3 or 5, or a portion thereof, has been immobilized; using Northern hybridization in which a polynucleotide having the nucleotide sequence shown in SEQ ID NO: 1, 3 or 5, or a portion thereof, is used as a probe; or using a PCR method in which a polynucleotide having the nucleotide sequence shown in SEQ ID NO: 1, 3 or 5, or a portion thereof, is used as a primer. For example, when the expression level of a periostin gene or the amount of a periostin protein in the above case (i) is higher than the expression level of a periostin gene or the amount of a periostin protein in the above case (ii); namely, when the expression level of a periostin gene or the amount of a periostin protein in the above case (i) is higher than the expression level of a periostin gene or the amount of a periostin protein in the above case (ii), for example, by approximately 20% or more, approximately 30% or more, approximately 40% or more, approximately 50% or more, approximately 60% or more, approximately 70% or more, approximately 80% or more, approximately 90% or more, approximately 95% or more, or approximately 100% or more, it can be determined that the subject is suspected to have idiopathic interstitial pneumonia. The disease type of idiopathic interstitial pneumonia that can be detected by the above-described method is, for example, idiopathic pulmonary fibrosis/usual interstitial pneumonia (IPF/UIP), or nonspecific interstitial pneumonia (NSIP). Specifically, it is IPF/UIP or fibrotic NSIP.

Otherwise, the expression level of a periostin gene or the amount of a periostin protein may also be measured by immunohistochemistry. More specifically, (i) the expression level of a periostin gene or the amount of a periostin protein in a biological sample derived from a subject is compared with (ii) the expression level of a periostin gene or the amount of a periostin protein in normal cells, for example. That is to say, periostin or mRNA encoding such periostin is visualized by immunohistochemistry, and the amounts of periostin proteins or the mRNA levels of both cases are then compared. As a biological sample, lung tissues and the like can be used. Specific examples of immunohistochemistry include an enzyme-labeled antibody method and a fluorescent antibody method. Examples of the enzyme-labeled antibody method include: labeled antibody methods such as a direct method, an indirect method, an avidin-biotinylated peroxidase complex method (ABC method) or a streptavidin biotinylated antibody method (SAB method); and unlabeled antibody methods such as a peroxidase-antiperoxidase method (PAP method). The fluorescent antibody method includes a direct method and an indirect method. Enzymes or fluorescent substances used for labeling are the same as those described above. For example, when the expression level of a periostin gene or the amount of a periostin protein in the above case (i)

is higher than the expression level of a periostin gene or the amount of a periostin protein in the above case (ii); namely, when the expression level of a periostin gene or the amount of a periostin protein in the above case (i) is higher than the expression level of a periostin gene or the amount of a periostin protein in the above case (ii), for example, by approximately 20% or more, approximately 30% or more, approximately 40% or more, approximately 50% or more, approximately 60% or more, approximately 70% or more, approximately 80% or more, approximately 90% or more, approximately 95% or more, or approximately 100% or more, it can be determined that the subject is suspected to have idiopathic interstitial pneumonia. The disease type of idiopathic interstitial pneumonia that can be detected by the above-described method is, for example, idiopathic pulmonary fibrosis/usual interstitial pneumonia (IPF/UIP), or non-specific interstitial pneumonia (NSIP). Specifically, it is IPF/UIP or fibrotic NSIP.

Herein, the difference between (i) the expression level of a periostin gene or the amount of a periostin protein in a biological sample derived from a subject and (ii) the expression level of a periostin gene or the amount of a periostin protein in normal cells is used as a critical value in the detection or diagnosis of idiopathic interstitial pneumonia. Such a critical value may be set as follows, for example. First, the expression levels of periostin genes or the amounts of periostin proteins in biological samples derived from two or more patients with idiopathic interstitial pneumonia (for example, IPF/UIP or fibrotic NSIP) are measured, and an average (A) is then obtained. In this operation, the number of target patients is two or more, and it is, for example, 5 or more, 10 or more, 50 or more, or 100 or more. On the other hand, the expression levels of periostin genes or the amounts of periostin proteins in cells derived from two or more normal persons are measured, and an average (B) is then obtained. In this operation, the number of target normal persons is two or more, and it is, for example, 5 or more, 10 or more, 50 or more, or 100 or more. Thereafter, $[(A-B)/B] \times 100(\%)$ is calculated using the obtained averages (A) and (B). The average of the expression levels of periostin genes or the amounts of periostin proteins in the biological samples derived from the patients with idiopathic interstitial pneumonia is compared with the average of the expression levels of periostin genes or the amounts of periostin proteins in the cells derived from the normal persons, and the percentage by which the former average is higher than the latter average is then determined. The thus determined value is defined as the difference (critical value) between (i) the expression levels of periostin genes or the amounts of periostin proteins in the biological samples derived from the subjects and (ii) the expression levels of periostin genes or the amounts of periostin proteins in the normal cells. That is, when the expression level of a periostin gene or the amount of a periostin protein in the above case (i) is higher than the difference obtained by comparing it with the expression level of a periostin gene or the amount of a periostin protein in the above case (ii) (for example, when it is statistically significantly high), it can be determined that the subject has or is suspected to have idiopathic interstitial pneumonia. In the method of the present invention for detecting or diagnosing idiopathic interstitial pneumonia, the expression level of a periostin gene or the amount of a periostin protein in a biological sample is measured. Thus, it is preferable to integrate measurement values into the averages (A) and (B), so that the number of target patients and the number of normal persons can increase. By increasing the number of cases, the accuracy of detection or diagnosis of idiopathic interstitial pneumonia can be enhanced. Moreover, the obtained average

(B) of the expression levels of periostin genes or the amounts of periostin proteins in cells derived from normal persons may also be defined as "(ii) the expression level of a periostin gene or the amount of a periostin protein in normal cells."

The aforementioned detection results or diagnostic results of idiopathic interstitial pneumonia can be used, for example, as auxiliary information in making the definitive diagnosis of idiopathic interstitial pneumonia. When the definitive diagnosis of idiopathic interstitial pneumonia is made, the aforementioned detection results may be combined with at least one selected from the group consisting of the results of physical findings, serological examination results (for example, serum KL-6, LDH or SC-A levels, etc.), respiratory function test results, the results of chest X-ray image findings, and the results of chest HRCT image findings, so that the definitive diagnosis may be comprehensively made.

4. The Kit of the Present Invention for Detecting or Diagnosing Idiopathic Interstitial Pneumonia

The present invention provides a kit that can be used for the above-described method for detecting or diagnosing idiopathic interstitial pneumonia.

In one embodiment of the present invention, the aforementioned kit comprises a polynucleotide having the nucleotide sequence of a periostin gene (for example, the nucleotide sequence shown in SEQ ID NO: 1, 3, or 5) or a portion thereof. Preferably, the aforementioned kit comprises a polynucleotide having the nucleotide sequence of a periostin gene, or a polynucleotide with a length of at least 21 nucleotides, which has a nucleotide sequence complementary to a complementary strand thereof. More preferably, the aforementioned kit may comprise the above-described polynucleotide, which is immobilized on a DNA chip.

In another embodiment of the present invention, the aforementioned kit comprises an antibody, which recognizes, and more preferably, specifically recognizes a peptide having the amino acid sequence of a periostin protein (for example, the amino acid sequence shown in SEQ ID NO: 2, 4 or 6). The aforementioned antibody may be either a monoclonal antibody or a polyclonal antibody. Thus, the type of the antibody is not limited. The antibody can be produced by a method well known in the present technical field.

As a method for producing an antibody, when the antibody to be produced is a polyclonal antibody, for example, an antigen, together with an adjuvant, is administered to a mammal such as a rabbit to carry out immunization for a predetermined period of time, so that an antiserum is obtained. For the measurement of an antibody titer, an ordinary enzyme immunoassay (an ELISA method or an EIA method) and the like can be adopted.

On the other hand, when a monoclonal antibody is produced, immunocompetent cells (splenic cells, etc.) collected from an animal immunized with an antigen are fused with myeloma cells, and the thus fused cells are then screened in a selective medium such as an HAT medium, so that a hybridoma producing an antibody of interest is obtained. This hybridoma is cultured, so that a monoclonal antibody of interest is obtained.

The aforementioned antibody may be labeled with a radioactive substance, a fluorescent substance, an enzyme, and the like. Moreover, the aforementioned kit may comprise a labeled secondary antibody.

The aforementioned kit may comprise a container and a label, as well as the above-described items. The label placed on or included with the container may describe that the kit is used for the detection or diagnosis of idiopathic interstitial pneumonia. Moreover, the kit may further comprise other items such as instructions for use.

5. The Screening Method of the Present Invention

The expression of a periostin gene is increased in tissues derived from a patient with idiopathic interstitial pneumonia. Thus, a compound that decreases the expression level of the periostin gene or the amount of the periostin protein when it is administered to the patient, or a salt thereof; namely, a compound that inhibits the aforementioned expression or a salt thereof can be used as a preventive and/or therapeutic agent for idiopathic interstitial pneumonia. That is to say, the present invention provides a method for screening for a compound that decreases the expression level of a periostin gene or the amount of a periostin protein, or a salt thereof, wherein the method comprises measuring the expression level of a periostin gene or the amount of a periostin protein, in a case in which cells having ability to produce periostin have been cultured in the presence of a candidate substance. More specifically, (i) a case in which cells having ability to produce periostin have been cultured in the presence of a candidate substance is compared with (ii) a case in which cells having ability to produce periostin have been cultured in the absence of a candidate substance, in terms of the expression level of a periostin gene or the amount of a periostin protein, for example. For the comparison, for example, the expression level of a periostin gene or the amount of a periostin protein is measured in both cases (i) and (ii), and the result of the case (i) is then compared with the result of the case (ii). Specifically, the amount of a periostin protein or the level of mRNA encoding periostin is measured in both cases (i) and (ii), and the result of the case (i) is then compared with the result of the case (ii). The cells having ability to produce periostin are, for example, cells transformed with a vector containing DNA encoding periostin. Examples of cells to be transformed include CHO cells, HEK293 cells, and 293 cells. The transformed cells may be cultured by a known method. Examples of the above-described candidate substance include a peptide, a protein, a synthetic compound, and a salt thereof. The amount of a periostin protein may be measured by the above-described immunoassay or a protein chip method, for example. The level of mRNA may be measured by a known method, such as a method using a polynucleotide having the nucleotide sequence of a periostin gene or a portion thereof. More specifically, for example, the measurement can be carried out using a DNA chip, on which a polynucleotide having the nucleotide sequence shown in SEQ ID NO: 1, 3 or 5, or a portion thereof, has been immobilized; using Northern hybridization in which a polynucleotide having the nucleotide sequence shown in SEQ ID NO: 1, 3 or 5, or a portion thereof, is used as a probe; or using a PCR method in which a polynucleotide having the nucleotide sequence shown in SEQ ID NO: 1, 3 or 5, or a portion thereof, is used as a primer. After completion of the measurement, for example, a candidate substance, which decreases the expression level of periostin or the amount of a periostin protein in the above case (i) when compared with that in the above case (ii); namely, a candidate substance, which decreases the expression level of periostin or the amount of a periostin protein in the above case (i), for example, by approximately 20% or more, approximately 30% or more, approximately 40% or more, approximately 50% or more, approximately 60% or more, approximately 70% or more, approximately 80% or more, approximately 90% or more, approximately 95% or more, or approximately 100% or more, when compared with that in the above case (ii), can be selected as a compound that inhibits the expression of a periostin gene, or a salt thereof.

6. The Screening Kit of the Present Invention

The present invention provides a kit that can be used for the above-described method for screening for a preventive and/or

therapeutic agent for idiopathic interstitial pneumonia. Specifically, the aforementioned kit comprises cells having ability to produce periostin. The “cells having ability to produce periostin” are as described above in the screening method of the present invention. The aforementioned kit may further comprise a medium used for cell culture, an antibiotic and a serum (a fetal bovine serum, etc.), which are to be added to the medium, and the like.

In addition, the kit may comprise a component used to measure the expression level of a periostin gene or the amount of a periostin protein. Examples of such a component include a polynucleotide having the nucleotide sequence of a periostin gene or a portion thereof, and an antibody that recognizes a peptide having the amino acid sequence of a periostin protein. These polynucleotide and antibody are the same as those described above.

The aforementioned kit may comprise a container and a label, as well as the above-described items. The label placed on or included with the container may describe that the kit is used to screen for a preventive and/or therapeutic agent for idiopathic interstitial pneumonia. Moreover, the kit may further comprise other items such as instructions for use.

Hereinafter, the present invention will be further specifically described in the following examples. However, these examples are not intended to limit the scope of the present invention.

EXAMPLES

(1) Production of Rabbit Polyclonal Anti-periostin Antibody

A recombinant protein formed by adding V5 epitope/His tag to periostin (nucleotide sequence: SEQ ID NO: 1, Accession No. D13666; amino acid sequence: SEQ ID NO: 2, Accession No. BAA02837) was expressed in S2 cells as insect cells, and it was then purified.

Specifically, transformants of S2 cells were produced as follows. cDNA encoding the above-described portion of periostin was inserted into a pMT/Bip/V5-HisA plasmid to produce pMT/Bip/V5-HisA-periostin. The pMT/Bip/V5-HisA-periostin and pCoHygro (Invitrogen) used as a plasmid for the expression of a hygromycin resistance gene were co-introduced into S2 cells according to a known method, so that the cells were transformed. Thereafter, transformants were selected using hygromycin, so that stable transformants were obtained.

Subsequently, V5 epitope/His tag-bound periostin was expressed in the transformants of the S2 cells.

The recombinant protein was purified as follows. Cupric sulfate was added to a medium comprising the stable transformants of the S2 cells containing periostin genes, so that the expression of the recombinant protein is induced. Thereby, the recombinant protein was expressed and secreted into a culture supernatant. This culture supernatant was dialyzed against PBS, and it was then mixed with a nickel resin (Ni-NTA Agarose, Qiagen, Hilden, Germany), so that the recombinant protein was allowed to bind to the resin. The resin was washed to remove contaminants, and the recombinant protein was then eluted with an imidazole-containing buffer. The eluted recombinant protein was dialyzed against PBS, and the resultant was used as an immunogen for animals.

Subsequently, such a recombinant protein was mixed with CFA (a complete Freund's adjuvant) (Freund's Adjuvant, Complete, manufactured by Sigma). A rabbit was immunized with the mixture, and serum was then collected from the rabbit.

Specific procedures are as follows. New Zealand White rabbits (female; body weight: 1.5-2 kg; KBT Oriental Co., Ltd., Tosu, Japan) were used.

These rabbits were immunized by injecting a mixture of recombinant periostin used as an immunogen and CFA into several sites in the dorsal subcutis of each rabbit.

Five to seven weeks after the immunization, blood was collected from the ear vein of each immunized rabbit, and serum was then obtained.

Finally, IgG was purified from the serum as follows. That is, to the collected serum, 50 mM sodium acetate (pH 4.0) was added in two times the amount of the serum. Thereafter, the pH of the obtained solution was adjusted to pH 4.0 by the addition of hydrochloric acid. While stirring the serum, caprylic acid was added thereto in an amount of $\frac{1}{5}$ of the serum. The obtained mixture was stirred for 30 minutes, and was then centrifuged at 9200 g for 10 minutes. The supernatant was dialyzed against PBS, so that purified IgG was prepared.

(2) Production of Rat Monoclonal Anti-periostin Antibody

A KLII (keyhole limpet hemocyanin)-bound human periostin peptide (20-50 $\mu\text{g}/\text{rat}$) or an S2 recombinant periostin protein (20-50 $\mu\text{g}/\text{rat}$) was mixed with CFA (a complete Freund's adjuvant) or TiterMax Gold (a chemically synthesized adjuvant), and the thus obtained binding form was used as an immunogen.

Specific procedures are as follows. The Sigma company was asked to produce a KLH-bound human periostin peptide by binding KLH having a maleimide group to a periostin peptide (CPVRKLQANKKVQGSRRRLR; SEQ ID NO: 7) produced by an Fmoc method.

Subsequently, an S2 recombinant periostin protein was produced as follows. First, cupric sulfate was added to a medium comprising the stable transformants of the S2 cells containing periostin genes, so that the expression of the recombinant periostin protein was induced. Thereby, the recombinant periostin protein was expressed and secreted into a culture supernatant. This culture supernatant was dialyzed against PBS, and it was then mixed with a nickel resin (Ni-NTA Agarose, Qiagen, Hilden, Germany), so that the recombinant periostin was allowed to bind to the resin. The resin was washed to remove contaminants, and the S2 recombinant periostin protein was then eluted with an imidazole-containing buffer.

As CFA, there was used Freund's Adjuvant, Complete, manufactured by Sigma. TiterMax Gold was purchased from Funakoshi Co., Ltd. CFA or TiterMax Gold was mixed at a volume ratio of 1:1 with a KLH-bound human periostin peptide solution or an S2 recombinant periostin protein solution.

Subsequently, 20-50 μg of the mixture of the KLH-bound human periostin peptide solution or S2 recombinant periostin protein solution and CFA or TiterMax Gold, which was used as an immunogen, was injected into the subcutis of the foot pad of a female rat. Ten days to two weeks later, 20-50 μg of the mixture of the KLH-bound human periostin peptide solution or S2 recombinant periostin protein solution and CFA or TiterMax Gold, used as an immunogen, was injected again into the subcutis of the foot pad of the female rat. In this experiment, a 6 to 8-week-old female Wistar rat (Charles River Laboratories Japan, Inc., Yokohama, Japan) was used.

Three to four days after the final immunization, cells in the popliteal, inguinal, and iliac lymph nodes of the immunized rat, were mixed with myeloma cells at a mixing ratio of 1:1 to 10:1, and polyethylene glycol was then added to the mixed cells according to an ordinary method, so that cell fusion was carried out. Thereafter, hybridoma colonies were selected.

Specifically, cell fusion was carried out as follows. The mixed lymph node cells and myeloma cells were centrifuged, and a supernatant was then removed. The residue was suspended in 1 ml of polyethylene glycol (PEG1500, Roche, Switzerland) at room temperature over 1 minute, and the suspension was then stirred at 37° C. for 1 minute. 1 ml of a serum-free medium was added to the reaction solution over 1 minute, and 10 ml of a serum-free medium was then added thereto over 1 minute. The cells were washed several times, and they were then dispensed in a 96-well plate, followed by performing culture at 37° C. in the presence of 5% CO₂.

As a method of selecting hybridoma cells, 7 to 14 days after the cell fusion, the peptide or protein used as an antigen was solid-phased, and selection of the hybridoma cells was then carried out in an ELISA system, in which the fused cell culture supernatant was used as a primary antibody. ELISA was specifically carried out as follows. The 1 $\mu\text{g}/\text{ml}$ peptide or protein was dispensed in a 96-well plate, and was then solid-phased for several hours. The solid-phased solution was washed, and the fused cell culture supernatant was then added to each well, followed by leaving it at rest at room temperature for 1 hour. Thereafter, the fused cell culture supernatant was washed, and a peroxidase-labeled goat anti-rat IgG antibody (GE Healthcare, Little Chalfont, U.K.) used as a secondary antibody was added thereto, followed by leaving it at rest at room temperature for 1 hour. After the secondary antibody had been washed, an ABTS peroxidase substrate (KPL, Gaithersburg, Md.) was added thereto for color development. Then, the absorbance at 405 nm was measured.

Thereafter, IgG was purified from the selected hybridoma cells as follows. The hybridoma cells were injected into the abdominal cavity of a 6 to 8-week-old female ICR-SCID mouse (CLEA Japan, Inc., Tokyo, Japan). Seven to ten days after the injection, accumulated ascites was collected. To the collected ascites, 50 mM sodium acetate (pH 4.0) was added in two times the amount of the ascites. Thereafter, the pH of the obtained solution was adjusted to pH 4.0 by the addition of hydrochloric acid. While stirring the serum, caprylic acid was added thereto in an amount of $\frac{1}{5}$ of the serum. The obtained mixture was stirred for 30 minutes, and was then centrifuged at 9200 g for 10 minutes. The supernatant was dialyzed against PBS, so that purified IgG was obtained.

(3) ELISA Measurement of Blood Periostin Level

A rabbit polyclonal anti-periostin antibody was solid-phased on a plate, and a standard substance or a biological sample (sample) was then added thereto.

Specifically, solid-phase preparation was carried out as follows. A 10 $\mu\text{g}/\text{ml}$ unlabeled rabbit polyclonal anti-periostin antibody was dispensed in a 96-well plate, and it was then solid-phased at 4° C. overnight.

An S2 recombinant periostin protein was used as a standard substance, and it was added at a concentration of 0-1000 ng/ml in an amount of 50 $\mu\text{l}/\text{well}$. As samples, blood collected from 13 IPF/UIP patients and blood collected from 12 normal persons were used. Such blood was collected from the peripheral vein, using a vacuum blood collecting tube, without the addition of heparin (plain). The collected blood was dispensed in tubes (1 ml per tube), and was then preserved at -30° C. The frozen blood samples were thawed before measurement, and serum was then recovered from the thawed blood by centrifugation. The serum was diluted by a factor of 10, and it was then added to the plate in an amount of 50 $\mu\text{l}/\text{well}$.

Thereafter, a biotin-labeled rabbit polyclonal anti-periostin antibody (1 $\mu\text{g}/\text{ml}$) used as a primary antibody was also added to the plate in an amount of 50 $\mu\text{l}/\text{well}$, and then, 50 $\mu\text{l}/\text{well}$ Eu (europium)-labeled streptavidin or 50 $\mu\text{l}/\text{well}$ HRP-labeled streptavidin was further added thereto. Subse-

quently, fluorescence or color developed was measured using a plate reader (ARVO MX, manufactured by Perkin Elmer). The measurement values of the samples were applied to a standard curve, which had been produced based on the measurement values of the standard substance, followed by calculation, so that the amount of periostin (ng/ml) contained in each sample was obtained.

The results are shown in FIG. 2. As shown in FIG. 2, the amount of periostin in the biological sample (IPF) derived from IPF/UIP patients was larger than that in the biological sample (Healthy Control) derived from normal persons (with a significant difference, $p < 0.001$). Moreover, when a comparison was made between the two types of biological samples in terms of mean value, the amount of a periostin protein in the biological sample (IPF/UIP) derived from the IPF/UIP patients was larger than that in the biological sample (Healthy Control) derived from the normal persons by approximately 95% ((the mean value of IPF periostin amount—the mean value of Healthy Control periostin amount) $\times 100$ %) = [(491–252)/252] $\times 100$ (%).

(4) Histoimmunostaining of Periostin

Periostin was histoimmunostained according to a histoimmunostaining method, which is generally referred to as an "ABC method."

Paraffin-embedded lung tissues were used as biological samples. Such paraffin-embedded lung tissues were produced by collecting lung tissues from each of 23 IPF/UIP patients, 23 fibrotic NSIP patients, 4 cellular NSIP patients and 6 normal persons, and then embedding the collected lung tissues in paraffin. The thus produced lung tissues were subjected to treatments such as deparaffinization, inhibition of endogenous peroxidase activity and blocking. Specifically, these operations were carried out as follows. The tissues were treated with methanol+3% H₂O₂ for 15 to 30 minutes, and were then treated with Protein Block Serum-Free (DAKO, Glostrup, Denmark) for 5 to 10 minutes.

The rabbit polyclonal anti-periostin antiserum or rat monoclonal anti-periostin antibody as produced above was used as a primary antibody, and it was added to the tissues in a

dilution factor of 1000 or in a concentration of 10 μ g/ml. Thereafter, an HRP-labeled antibody (Envision, purchased from DAKO) directed against the primary antibody was added as a secondary antibody, and color was then developed with DAB (diaminobenzidine) (Sigma).

Thereafter, operations such as nuclear staining, dehydration and mounting were carried out. Specifically, these operations were carried out as follows. 100 μ l of the primary antibody was placed on the tissues, and it was then left at rest at room temperature for 60 minutes. The primary antibody was then washed. Thereafter, 100 μ l of the secondary antibody was placed on the tissues, and it was then left at rest at room temperature for 60 minutes. The secondary antibody was then washed. Subsequently, the tissue slide was immersed in a DAB substrate solution, so that color was developed for 1 to 20 minutes. Thereafter, the resultant was subjected to nuclear staining with hematoxylin, and was then subjected to dehydration and mounting according to known methods.

As a result, it was found that the expression level of a periostin gene was high in all of the 23 IPF/UIP patients and the 23 fibrotic NSIP patients (FIGS. 1(a) and (b)). The expression level of a periostin gene was extremely low in the 4 cellular NSIP patients (FIG. 1(c)). In contrast, the expression level of a periostin gene was extremely low in all of the lung tissues from the 6 normal persons who constituted a control group (FIG. 1(d)).

As described in the above examples, since the expression of a periostin gene is increased in tissues derived from a patient with idiopathic interstitial pneumonia, periostin in a biological sample derived from a subject can be used as a marker for detecting or diagnosing idiopathic interstitial pneumonia.

Moreover, since the expression of the periostin gene is increased in tissues derived from a patient with idiopathic interstitial pneumonia, a compound that inhibits the expression of the periostin gene or a salt thereof can be used as a preventive and/or therapeutic agent for idiopathic interstitial pneumonia.

[Sequence Listing Free Text]

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SEQUENCE LISTING

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      15             20             25

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Gly	Lys	Gly	Phe	Glu	Pro	Gly	Val	Thr	Asn	Ile	Leu	Lys	Thr	Thr	Gln	
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gga	agc	aaa	atc	ttt	ctg	aaa	gaa	gta	aat	gat	aca	ctt	ctg	gtg	aat	1826
Gly	Ser	Lys	Ile	Phe	Leu	Lys	Glu	Val	Asn	Asp	Thr	Leu	Leu	Val	Asn	
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Glu	Leu	Lys	Ser	Lys	Glu	Ser	Asp	Ile	Met	Thr	Thr	Asn	Gly	Val	Ile	
				610					615					620		
cat	ggt	gta	gat	aaa	ctc	ctc	tat	cca	gca	gac	aca	cct	ggt	gga	aat	1922
His	Val	Val	Asp	Lys	Leu	Leu	Tyr	Pro	Ala	Asp	Thr	Pro	Val	Gly	Asn	
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gat	caa	ctg	ctg	gaa	ata	ctt	aat	aaa	tta	atc	aaa	tac	atc	caa	att	1970
Asp	Gln	Leu	Leu	Glu	Ile	Leu	Asn	Lys	Leu	Ile	Lys	Tyr	Ile	Gln	Ile	
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Lys	Phe	Val	Arg	Gly	Ser	Thr	Phe	Lys	Glu	Ile	Pro	Val	Thr	Val	Tyr	
		655				660					665					
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Thr	Thr	Lys	Ile	Ile	Thr	Lys	Val	Val	Glu	Pro	Lys	Ile	Lys	Val	Ile	
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gaa	ggc	agt	ctt	cag	cct	att	atc	aaa	act	gaa	gga	ccc	aca	cta	aca	2114
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690 695 700

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gaa aca ata act gaa gtc cat gga gaa gag cca atc ata aaa tac
Gln Thr Ile Thr Gln Val Ile His Gly Gln Pro Ile Ile Lys Lys Tyr
2210
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Thr Lys Ile Ile Asp Gly Val Pro Val Gln Ile Thr Gln Lys Gln Thr
2258
cga gaa gaa cga atc atc aca ggt cct gaa ata aaa tac act agg atc
Arg Gln Gln Arg Ile Ile Thr Gly Pro Gln Ile Lys Tyr Thr Arg Ile
2306
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Ser Thr Gly Gly Gly Gln Thr Gln Thr Gln Thr Leu Lys Lys Leu Gln
2354
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Gln Gln Val Thr Lys Phe Ile Gln Gly Asp Gly His
2402
tca ttc gaa gat gaa gaa atc aaa aga ctg ctc cag gga gac aca ccc
Leu Phe Gln Asp Gln Ile Lys Arg Leu Leu Gln Gly Asp Thr Pro
2450
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Val Arg Lys Leu Gln Ala Asn Lys Lys Val Gln Gly Ser Arg Arg Arg
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Leu Arg Gln Gly Arg Ser Gln
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3092
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3212
3213 a

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<212> TYPE: PRT
<213> ORGANISM: Homo sapiens
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25
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Arg Ile Arg Gly Arg Asp Gln Gly Pro Asn Val Cys Ala Leu Gln Gln
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Ile Leu Gly Thr Lys Lys Lys Tyr Phe Ser Thr Cys Lys Asn Trp Tyr

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Lys	Lys	Ser	Ile	Cys	Gly	Gln	Lys	Thr	Thr	Val	Leu	Tyr	Glu	Cys	Cys
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Pro	Gly	Tyr	Met	Arg	Met	Glu	Gly	Met	Lys	Gly	Cys	Pro	Ala	Val	Leu
			85						90					95	
Pro	Ile	Asp	His	Val	Tyr	Gly	Thr	Leu	Gly	Ile	Val	Gly	Ala	Thr	Thr
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Thr	Gln	Arg	Tyr	Ser	Asp	Ala	Ser	Lys	Leu	Arg	Glu	Glu	Ile	Glu	Gly
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Lys	Gly	Ser	Phe	Thr	Tyr	Phe	Ala	Pro	Ser	Asn	Glu	Ala	Trp	Asp	Asn
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Leu	Asp	Ser	Asp	Ile	Arg	Arg	Gly	Leu	Glu	Ser	Asn	Val	Asn	Val	Glu
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Leu	Leu	Asn	Ala	Leu	His	Ser	His	Met	Ile	Asn	Lys	Arg	Met	Leu	Thr
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Lys	Asp	Leu	Lys	Asn	Gly	Met	Ile	Ile	Pro	Ser	Met	Tyr	Asn	Asn	Leu
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Gly	Leu	Phe	Ile	Asn	His	Tyr	Pro	Asn	Gly	Val	Val	Thr	Val	Asn	Cys
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Ala	Arg	Ile	Ile	His	Gly	Asn	Gln	Ile	Ala	Thr	Asn	Gly	Val	Val	His
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Val	Ile	Asp	Arg	Val	Leu	Thr	Gln	Ile	Gly	Thr	Ser	Ile	Gln	Asp	Phe
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Ile	Glu	Ala	Glu	Asp	Asp	Leu	Ser	Ser	Phe	Arg	Ala	Ala	Ala	Ile	Thr
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Ser	Asp	Ile	Leu	Glu	Ala	Leu	Gly	Arg	Asp	Gly	His	Phe	Thr	Leu	Phe
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Ala	Pro	Thr	Asn	Glu	Ala	Phe	Glu	Lys	Leu	Pro	Arg	Gly	Val	Leu	Glu
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Arg	Phe	Met	Gly	Asp	Lys	Val	Ala	Ser	Glu	Ala	Leu	Met	Lys	Tyr	His
		290				295						300			
Ile	Leu	Asn	Thr	Leu	Gln	Cys	Ser	Glu	Ser	Ile	Met	Gly	Gly	Ala	Val
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Phe	Glu	Thr	Leu	Glu	Gly	Asn	Thr	Ile	Glu	Ile	Gly	Cys	Asp	Gly	Asp
				325					330					335	
Ser	Ile	Thr	Val	Asn	Gly	Ile	Lys	Met	Val	Asn	Lys	Lys	Asp	Ile	Val
			340					345					350		
Thr	Asn	Asn	Gly	Val	Ile	His	Leu	Ile	Asp	Gln	Val	Leu	Ile	Pro	Asp
			355				360						365		
Ser	Ala	Lys	Gln	Val	Ile	Glu	Leu	Ala	Gly	Lys	Gln	Gln	Thr	Thr	Phe
			370				375					380			
Thr	Asp	Leu	Val	Ala	Gln	Leu	Gly	Leu	Ala	Ser	Ala	Leu	Arg	Pro	Asp
385					390					395					400
Gly	Glu	Tyr	Thr	Leu	Leu	Ala	Pro	Val	Asn	Asn	Ala	Phe	Ser	Asp	Asp
				405					410					415	
Thr	Leu	Ser	Met	Val	Gln	Arg	Leu	Leu	Lys	Leu	Ile	Leu	Gln	Asn	His
			420					425					430		
Ile	Leu	Lys	Val	Lys	Val	Gly	Leu	Asn	Glu	Leu	Tyr	Asn	Gly	Gln	Ile
			435				440						445		
Leu	Glu	Thr	Ile	Gly	Gly	Lys	Gln	Leu	Arg	Val	Phe	Val	Tyr	Arg	Thr
			450				455					460			
Ala	Val	Cys	Ile	Glu	Asn	Ser	Cys	Met	Glu	Lys	Gly	Ser	Lys	Gln	Gly
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Leu Ile Val Asn Pro Ile Asn Ala Asn Asn His Tyr Asp Lys Ile Leu	
15 20 25	
gct cat agt cgt atc agg ggt cgg gac caa gcc cca aat gtc tgt gcc	146
Ala His Ser Arg Ile Arg Gly Arg Asp Gln Gly Pro Asn Val Cys Ala	
30 35 40 45	
ctt caa cag att ttg ggc acc aaa aag aaa tac ttc agc act tgt aag	194
Leu Gln Gln Ile Leu Gly Thr Lys Lys Lys Tyr Phe Ser Thr Cys Lys	
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aac tgg tat aaa aag tcc atc tgt gga cag aaa acg act gtt tta tat	242
Asn Trp Tyr Lys Lys Ser Ile Cys Gly Gln Lys Thr Thr Val Leu Tyr	
65 70 75	
gaa tgt tgc cct ggt tat atg aga atg gaa gga atg aaa ggc tgc cca	290
Glu Cys Cys Pro Gly Tyr Met Arg Met Glu Gly Met Lys Gly Cys Pro	
80 85 90	
gca gtt ttg ccc att gac cat gtt tat ggc act ctg gcc atc gtg gga	338
Ala Val Leu Pro Ile Asp His Val Tyr Gly Thr Leu Gly Ile Val Gly	
95 100 105	
gcc acc aca acg cag cgc tat tct gac gcc tca aaa ctg agg gag gag	386
Ala Thr Thr Thr Gln Arg Tyr Ser Asp Ala Ser Lys Leu Arg Glu Glu	
110 115 120 125	
atc gag gga aag gga tcc ttc act tac ttt gca ccg agt aat gag gct	434
Ile Glu Gly Lys Gly Ser Phe Thr Tyr Phe Ala Pro Ser Asn Glu Ala	
130 135 140	
tgg gac aac ttg gat tct gat atc cgt aga ggt ttg gag agc aac gtg	482
Trp Asp Asn Leu Asp Ser Asp Ile Arg Arg Gly Leu Glu Ser Asn Val	
145 150 155	
aat gtt gaa tta ctg aat gct tta cat agt cac atg att aat aag aga	530
Asn Val Glu Leu Leu Asn Ala Leu His Ser His Met Ile Asn Lys Arg	
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atg ttg acc aag gac tta aaa aat ggc atg att att cct tca atg tat	578
Met Leu Thr Lys Asp Leu Lys Asn Gly Met Ile Ile Pro Ser Met Tyr	
175 180 185	
aac aat ttg ggg ctt ttc att aac cat tat cct aat ggg gtt gtc act	626
Asn Asn Leu Gly Leu Phe Ile Asn His Tyr Pro Asn Gly Val Val Thr	
190 195 200 205	
gtt aat tgt gct cga atc atc cat ggg aac cag att gca aca aat ggt	674
Val Asn Cys Ala Arg Ile Ile His Gly Asn Gln Ile Ala Thr Asn Gly	
210 215 220	
gtt gtc cat gtc att gac cgt gtg ctt aca caa att ggt acc tca att	722
Val Val His Val Ile Asp Arg Val Leu Thr Gln Ile Gly Thr Ser Ile	
225 230 235	
caa gac ttc att gaa gca gaa gat gac ctt tca tct ttt aga gca gct	770
Gln Asp Phe Ile Glu Ala Glu Asp Asp Leu Ser Ser Phe Arg Ala Ala	
240 245 250	
gcc atc aca tcg gac ata ttg gag gcc ctt gga aga gac ggt cac ttc	818
Ala Ile Thr Ser Asp Ile Leu Glu Ala Leu Gly Arg Asp Gly His Phe	
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aca ctc ttt gct ccc acc aat gag gct ttt gag aaa ctt cca cga ggt	866
Thr Leu Phe Ala Pro Thr Asn Glu Ala Phe Glu Lys Leu Pro Arg Gly	
270 275 280 285	
gtc cta gaa agg ttc atg gga gac aaa gtg gct tcc gaa gct ctt atg	914
Val Leu Glu Arg Phe Met Gly Asp Lys Val Ala Ser Glu Ala Leu Met	
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aag tac cac atc tta aat act ctc cag tgt tct gag tct att atg gga	962
Lys Tyr His Ile Leu Asn Thr Leu Gln Cys Ser Glu Ser Ile Met Gly	
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gac ggt gac agt ata aca gta aat gga atc aaa atg gtg aac aaa aag	1058
Asp Gly Asp Ser Ile Thr Val Asn Gly Ile Lys Met Val Asn Lys Lys	
335 340 345	
gat att gtg aca aat aat ggt gtg atc cat ttg att gat cag gtc cta	1106
Asp Ile Val Thr Asn Asn Gly Val Ile His Leu Ile Asp Gln Val Leu	
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att cct gat tct gcc aaa caa gtt att gag ctg gct gga aaa cag caa	1154
Ile Pro Asp Ser Ala Lys Gln Val Ile Glu Leu Ala Gly Lys Gln Gln	
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acc acc ttc acg gat ctt gtg gcc caa tta ggc ttg gca tct gct ctg	1202
Thr Thr Phe Thr Asp Leu Val Ala Gln Leu Gly Leu Ala Ser Ala Leu	
385 390 395	
agg cca gat gga gaa tac act ttg ctg gca cct gtg aat aat gca ttt	1250
Arg Pro Asp Gly Glu Tyr Thr Leu Leu Ala Pro Val Asn Asn Ala Phe	
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tct gat gat act ctc agc atg gtt cag cgc ctc ctt aaa tta att ctg	1298
Ser Asp Asp Thr Leu Ser Met Val Gln Arg Leu Leu Lys Leu Ile Leu	
415 420 425	
cag aat cac ata ttg aaa gta aaa gtt ggc ctt aat gag ctt tac aac	1346
Gln Asn His Ile Leu Lys Val Lys Val Gly Leu Asn Glu Leu Tyr Asn	
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Gly Gln Ile Leu Thr Ile Gly Gly Lys Gln Leu Arg Val Phe Val	
450 455 460	
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Tyr Arg Thr Ala Val Cys Ile Glu Asn Ser Cys Met Glu Lys Gly Ser	
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Lys Gln Gly Arg Asn Gly Ala Ile His Ile Phe Arg Glu Ile Ile Lys	
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cca gca gag aaa tcc ctc cat gaa aag tta aaa caa gat aag cgc ttt	1538
Pro Ala Glu Lys Ser Leu His Glu Lys Leu Lys Gln Asp Lys Arg Phe	
495 500 505	
agc acc ttc ctc agc cta ctt gaa gct gca gac ttg aaa gag ctc ctg	1586
Ser Thr Phe Leu Ser Leu Leu Glu Ala Ala Asp Leu Lys Glu Leu Leu	
510 515 520 525	
aca caa cct gga gac tgg aca tta ttt gtg cca acc aat gat gct ttt	1634
Thr Gln Pro Gly Asp Trp Thr Leu Phe Val Pro Thr Asn Asp Ala Phe	
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Lys Gly Met Thr Ser Glu Glu Lys Glu Ile Leu Ile Arg Asp Lys Asn	
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Ala Leu Gln Asn Ile Ile Leu Tyr His Leu Thr Pro Gly Val Phe Ile	
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gga aaa gga ttt gaa cct ggt gtt act aac att tta aag acc aca caa	1778
Gly Lys Gly Phe Glu Pro Gly Val Thr Asn Ile Leu Lys Thr Thr Gln	
575 580 585	
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Gly Ser Lys Ile Phe Leu Lys Glu Val Asn Asp Thr Leu Leu Val Asn	
590 595 600 605	
gaa ttg aaa tca aaa gaa tct gac atc atg aca aca aat ggt gta att	1874
Glu Leu Lys Ser Lys Glu Ser Asp Ile Met Thr Thr Asn Gly Val Ile	
610 615 620	
cat gtt gta gat aaa ctc ctc tat cca gca gac aca cct gtt gga aat	1922
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aag ttt gtt cgt ggt agc acc ttc aaa gaa atc ccc gtg act gtc tat 2018
Lys Phe Val Arg Gly Ser Thr Phe Lys Glu Ile Pro Val Thr Val Tyr
      655                660                665

aag cca att att aaa aaa tac acc aaa atc att gat gga gtg cct gtg 2066
Lys Pro Ile Ile Lys Lys Tyr Thr Lys Ile Ile Asp Gly Val Pro Val
      670                675                680                685

gaa ata act gaa aaa gag aca cga gaa gaa cga atc att aca ggt cct 2114
Glu Ile Thr Glu Lys Glu Thr Arg Glu Glu Arg Ile Ile Thr Gly Pro
      690                695                700

gaa ata aaa tac act agg att tct act gga ggt gga gaa aca gaa gaa 2162
Glu Ile Lys Tyr Thr Arg Ile Ser Thr Gly Gly Gly Glu Thr Glu Glu
      705                710                715

act ctg aag aaa ttg tta caa gaa gac aca ccc gtg agg aag ttg caa 2210
Thr Leu Lys Lys Leu Leu Gln Glu Asp Thr Pro Val Arg Lys Leu Gln
      720                725                730

gcc aac aaa aaa gtt caa ggt tct aga aga cga tta agg gaa ggt cgt 2258
Ala Asn Lys Lys Val Gln Gly Ser Arg Arg Arg Leu Arg Glu Gly Arg
      735                740                745

tct cag tga aaatcaaaa accagaaaa aatgtttata caaccctaag 2307
Ser Gln
750

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aatctcaaac gtttcaataa aaccattttt cagatataaa gagaattact tcaaattgag 2907
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<210> SEQ ID NO 4

<211> LENGTH: 751

<212> TYPE: PRT

<213> ORGANISM: Homo sapiens

<400> SEQUENCE: 4

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Arg Ile Arg Gly Arg Asp Gln Gly Pro Asn Val Cys Ala Leu Gln Gln
      35           40           45

Ile Leu Gly Thr Lys Lys Lys Tyr Phe Ser Thr Cys Lys Asn Trp Tyr
      50           55           60

Lys Lys Ser Ile Cys Gly Gln Lys Thr Thr Val Leu Tyr Glu Cys Cys
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Pro Gly Tyr Met Arg Met Glu Gly Met Lys Gly Cys Pro Ala Val Leu
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 Lys Gly Ser Phe Thr Tyr Phe Ala Pro Ser Asn Glu Ala Trp Asp Asn
 130 135 140
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 145 150 155 160
 Leu Leu Asn Ala Leu His Ser His Met Ile Asn Lys Arg Met Leu Thr
 165 170 175
 Lys Asp Leu Lys Asn Gly Met Ile Ile Pro Ser Met Tyr Asn Asn Leu
 180 185 190
 Gly Leu Phe Ile Asn His Tyr Pro Asn Gly Val Val Thr Val Asn Cys
 195 200 205
 Ala Arg Ile Ile His Gly Asn Gln Ile Ala Thr Asn Gly Val Val His
 210 215 220
 Val Ile Asp Arg Val Leu Thr Gln Ile Gly Thr Ser Ile Gln Asp Phe
 225 230 235 240
 Ile Glu Ala Glu Asp Asp Leu Ser Ser Phe Arg Ala Ala Ala Ile Thr
 245 250 255
 Ser Asp Ile Leu Glu Ala Leu Gly Arg Asp Gly His Phe Thr Leu Phe
 260 265 270
 Ala Pro Thr Asn Glu Ala Phe Glu Lys Leu Pro Arg Gly Val Leu Glu
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 Arg Phe Met Gly Asp Lys Val Ala Ser Glu Ala Leu Met Lys Tyr His
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 Ile Leu Asn Thr Leu Gln Cys Ser Glu Ser Ile Met Gly Gly Ala Val
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 325 330 335
 Ser Ile Thr Val Asn Gly Ile Lys Met Val Asn Lys Lys Asp Ile Val
 340 345 350
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 Ser Ala Lys Gln Val Ile Glu Leu Ala Gly Lys Gln Gln Thr Thr Phe
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 Thr Asp Leu Val Ala Gln Leu Gly Leu Ala Ser Ala Leu Arg Pro Asp
 385 390 395 400
 Gly Glu Tyr Thr Leu Leu Ala Pro Val Asn Asn Ala Phe Ser Asp Asp
 405 410 415
 Thr Leu Ser Met Val Gln Arg Leu Leu Lys Leu Ile Leu Gln Asn His
 420 425 430
 Ile Leu Lys Val Lys Val Gly Leu Asn Glu Leu Tyr Asn Gly Gln Ile
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 Leu Glu Thr Ile Gly Gly Lys Gln Leu Arg Val Phe Val Tyr Arg Thr
 450 455 460
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 465 470 475 480
 Arg Asn Gly Ala Ile His Ile Phe Arg Glu Ile Ile Lys Pro Ala Glu
 485 490 495
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 515 520 525

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 580 585 590
 Ile Phe Leu Lys Glu Val Asn Asp Thr Leu Leu Val Asn Glu Leu Lys
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 Ser Lys Glu Ser Asp Ile Met Thr Thr Asn Gly Val Ile His Val Val
 610 615 620
 Asp Lys Leu Leu Tyr Pro Ala Asp Thr Pro Val Gly Asn Asp Gln Leu
 625 630 635 640
 Leu Glu Ile Leu Asn Lys Leu Ile Lys Tyr Ile Gln Ile Lys Phe Val
 645 650 655
 Arg Gly Ser Thr Phe Lys Glu Ile Pro Val Thr Val Tyr Lys Pro Ile
 660 665 670
 Ile Lys Lys Tyr Thr Lys Ile Ile Asp Gly Val Pro Val Glu Ile Thr
 675 680 685
 Glu Lys Glu Thr Arg Glu Glu Arg Ile Ile Thr Gly Pro Glu Ile Lys
 690 695 700
 Tyr Thr Arg Ile Ser Thr Gly Gly Gly Glu Thr Glu Glu Thr Leu Lys
 705 710 715 720
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 1 5 10
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 Leu Ile Val Asn Pro Ile Asn Ala Asn Asn His Tyr Asp Lys Ile Leu
 15 20 25
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 Ala His Ser Arg Ile Arg Gly Arg Asp Gln Gly Pro Asn Val Cys Ala
 30 35 40 45
 ctt caa cag att ttg ggc acc aaa aag aaa tac ttc agc act tgt aag 194
 Leu Gln Gln Ile Leu Gly Thr Lys Lys Lys Tyr Phe Ser Thr Cys Lys
 50 55 60
 aac tgg tat aaa aag tcc atc tgt gga cag aaa acg act gtg tta tat 242
 Asn Trp Tyr Lys Lys Ser Ile Cys Gly Gln Lys Thr Thr Val Leu Tyr
 65 70 75
 gaa tgt tgc cct ggt tat atg aga atg gaa gga atg aaa ggc tgc cca 290
 Glu Cys Cys Pro Gly Tyr Met Arg Met Glu Gly Met Lys Gly Cys Pro
 80 85 90
 gca gtt ttg ccc att gac cat gtt tat ggc act ctg ggc atc gtg gga 338
 Ala Val Leu Pro Ile Asp His Val Tyr Gly Thr Leu Gly Ile Val Gly

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aat gtt gaa tta ctg aat gct tta cat agt cac atg att aat aag aga Asn Val Glu Leu Leu Asn Ala Leu His Ser His Met Ile Asn Lys Arg 160 165 170			530
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aac aat ttg ggg ctt ttc att aac cat tat cct aat ggg gtt gtc act Asn Asn Leu Gly Leu Phe Ile Asn His Tyr Pro Asn Gly Val Val Thr 190 195 200 205			626
gtt aat tgt gct cga atc atc cat ggg aac cag att gca aca aat ggt Val Asn Cys Ala Arg Ile Ile His Gly Asn Gln Ile Ala Thr Asn Gly 210 215 220			674
gtt gtc cat gtc att gac cgt gtg ctt aca caa att ggt acc tca att Val Val His Val Ile Asp Arg Val Leu Thr Gln Ile Gly Thr Ser Ile 225 230 235			722
caa gac ttc att gaa gca gaa gat gac ctt tca tct ttt aga gca gct Gln Asp Phe Ile Glu Ala Glu Asp Asp Leu Ser Ser Phe Arg Ala Ala 240 245 250			770
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gtc cta gaa agg atc atg gga gac aaa gtg gct tcc gaa gct ctt atg Val Leu Glu Arg Ile Met Gly Asp Lys Val Ala Ser Glu Ala Leu Met 290 295 300			914
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gga gca gtc ttt gag acg ctg gaa gga aat aca att gag ata gga tgt Gly Ala Val Phe Glu Thr Leu Glu Gly Asn Thr Ile Glu Ile Gly Cys 320 325 330			1010
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gat att gtg aca aat aat ggt gtg atc cat ttg att gat cag gtc cta Asp Ile Val Thr Asn Asn Gly Val Ile His Leu Ile Asp Gln Val Leu 350 355 360 365			1106
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acc acc ttc acg gat ctt gtg gcc caa tta ggc ttg gca tct gct ctg Thr Thr Phe Thr Asp Leu Val Ala Gln Leu Gly Leu Ala Ser Ala Leu 385 390 395			1202
agg cca gat gga gaa tac act ttg ctg gca cct gtg aat aat gca ttt Arg Pro Asp Gly Glu Tyr Thr Leu Leu Ala Pro Val Asn Asn Ala Phe 400 405 410			1250
tct gat gat act ctc agc atg gat cag cgc ctc ctt aaa tta att ctg Ser Asp Asp Thr Leu Ser Met Asp Gln Arg Leu Leu Lys Leu Ile Leu			1298

415	420	425
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cca gca gag aaa tcc ctc cat gaa aag tca aaa gat aag cgc ttc pro ala gin lys ser leu his gin lys leu lys gin asp lys arg phe 495 500 505	agc acc ttc ctc agc cta ctt gaa gct gca gac tgc aaa gag ctc ctg ser thr phe leu ser leu ala asp leu lys gin leu leu 510 515 520 525	aca caa cct gga gac tgc aca tta ttc gtc cca acc aat gat gct ttc thr gin pro gly asp trp thr leu phe val pro thr asn asp ala phe 530 535 540
aag gga atg act agt gaa aaa gaa aat ctg ata cgg gac aaa aat lys gly met thr ser gin lys gin ile leu ile arg asp lys asn 545 550 555	gct ctt caa aac atc atc ttt lat cac ctg aca cca gga gtc ttc atc ala leu gin asn ile ile leu tyr his leu thr pro gly val phe ile 560 565 570	gga aaa gga ttc gaa cct ggt gtc act aac atc tta aag acc aca caa gly lys gly phe gin pro gly val thr thr gin 575 580 585
gga agc aaa atc ttt ctg aaa gaa gta aat gat aca ctt ctg gtc aat gly ser lys ile phe leu lys gin val asn asp thr leu leu val asn 590 595 600 605	gaa tgc aaa tca aaa gaa tct gac atc atg aca aca aat ggt gra atc gin leu lys ser lys gin ser asp ile met thr thr asn gly val ile 610 615 620	cat gtc gta gat aaa ctc ctc lat cca gca gac aca cct gtc gga aat his val val asp lys leu leu tyr pro ala asp thr pro val gly asn 625 630 635
gat caa ctg ctg gaa ata ctt aat aaa tta aac aca lac atc caa atc asp gin leu leu gin ile leu asn lys leu ile lys tyr ile gin ile 640 645	aag ttt gtc cgt ggt agc acc ttc aaa gaa atc ccc gtc act gtc lat lys phe val arg gly ser thr phe lys gin ile pro val thr val tyr 655 660 665	aga ccc aca cta aca aaa gtc aaa atc gaa ggt gaa cct gaa ttc aga arg pro thr leu thr lys val lys ile gin gly pro gin phe arg 670 675 680 685
ctg atc aaa gaa ggt gaa aca ata act gaa gtc atc cat gga gag cca leu ile lys gin gly thr ile thr gin val ile his gly gin pro 690 695 700	att att aaa aaa tgc acc aaa atc att gat gga gtc cct gtc gaa ata ile ile lys lys tyr thr lys ile ile asp gly val pro val gin ile 705 710 715	act gaa aaa gag aca cga gaa cga atc atc aca ggt cct gaa ata thr gin lys gin thr arg gin arg ile ile thr gly pro gin ile 720 725 730
aaa tac act agt att tct act gga ggt gga gaa aca gaa gaa act ctg lys tyr thr arg ile ser thr gly gly gln thr gin gln thr leu 2258	2162	2210
2114	2066	2018
1970	1922	1874
1826	1778	1730
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1394	1346	

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Leu Gln Glu Glu Asp Thr Pro Val Arg Lys Leu Gln Ala Asn Lys Lys
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Val Gln Gly Ser Arg Arg Arg Leu Arg Glu Gly Arg Ser Gln
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<212> TYPE: PRT
<213> ORGANISM: Artificial sequence
<220> FEATURE:
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 1              5              10              15

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Arg Arg Leu Arg
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The invention claimed is:

1. A method for detecting idiopathic interstitial pneumonia, which comprises:

- a) obtaining a biological sample from a subject suspected of having idiopathic interstitial pneumonia; and
- b) measuring the expression level of a periostin gene or the amount of a periostin protein in a biological sample obtained from the subject suspected of having idiopathic interstitial pneumonia,

wherein the periostin gene is selected from the group consisting of polynucleotide sequences set forth in SEQ ID NOs: 1, 3 and 5, and wherein the periostin protein is selected from the group consisting of amino acid sequences set forth in SEQ ID NOs: 2, 4 and 6, and

wherein an elevated expression level of the periostin gene or an elevated amount of the periostin protein is indicative of idiopathic interstitial pneumonia,

wherein the subject is suspected of having idiopathic interstitial pneumonia by having tested positive for idiopathic interstitial pneumonia with at least one selected from the group consisting of the results of physical findings, serological examination results, respiratory function test results, the results of chest X-ray image findings, and the results of chest HRCT image findings.

2. The method according to claim 1, wherein the idiopathic interstitial pneumonia is idiopathic pulmonary fibrosis or nonspecific interstitial pneumonia.

3. The method according to claim 2, wherein the nonspecific interstitial pneumonia is fibrotic nonspecific interstitial pneumonia (fibrotic NSIP).

4. The method according to claim 1, wherein the measurement is carried out by an immunoassay.

5. The method according to claim 1, wherein the biological sample is lung tissues and/or blood.

6. The method according to claim 1, which comprises comparing (i) the expression level of a periostin gene or the amount of a periostin protein in a biological sample derived from a subject, with (ii) the expression level of a periostin gene or the amount of a periostin protein in a biological sample derived from a normal person.

7. The method according to claim 6, which comprises determining that the subject has or is suspected to have idiopathic interstitial pneumonia, when (i) the expression level of a periostin gene or the amount of a periostin protein in the biological sample derived from the subject is higher than (ii) the expression level of a periostin gene or the amount of a periostin protein in the biological sample derived from a normal person.

8. The method according to claim 1, wherein the periostin gene is the polynucleotide sequence set forth in SEQ ID NO: 1, and wherein the periostin protein is the amino acid sequence set forth in SEQ ID NO: 2.

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