

Description

DEVICE FOR IDENTIFICATION OR AUXILIARY IDENTIFICATION OF ACUTE CHEST PAIN TYPE AND USE THEREOF

Technical Field

The present invention relates to a device for identification or auxiliary identification of an acute chest pain type and use thereof in the field of medical care informatics.

Background Art

Acute chest pain refers to non-traumatic pain or other chest discomfort that occurs within 24 hours of onset. Acute chest pain related to cardiovascular diseases includes acute myocardial infarction (AMI), acute aortic dissection (AAD), and acute pulmonary embolism (APE), which are extremely dangerous during onset and have a high mortality rate. They are all presented with symptoms of acute chest pain clinically, but different treatment methods are required because of different disease mechanisms. Acute myocardial infarction is caused by coronary thrombosis leading to myocardial ischemia. Acute pulmonary embolism is caused by the occlusion of pulmonary arteries by endogenous or exogenous emboli, resulting in pulmonary circulation and right heart dysfunctions. Both diseases require rapid diagnosis followed by anticoagulation, thrombolysis and other therapies. Acute aortic dissection means tearing of the intima and media of the aorta caused by various reasons, where the intima of the aorta is separated from the media, and the blood flows in, resulting in the aortic lumen being partitioned into a true lumen and a false lumen. If there is a diagnostic error, performing thrombolysis or other therapies may exacerbate the progression of a disease and endanger the patient's life. Therefore, there is an urgent need for biomarkers that can provide additional information beyond the existing clinical diagnostic methods to assist in the differential diagnosis of patients with acute fatal chest pain.

AMI, AAD and APE can all induce chest pain, thereby increasing the difficulty of clinical diagnosis and differential diagnosis, and leading to missed diagnosis and misdiagnosis. D-dimer is a specific degradation product produced by plasmin hydrolysis of cross-linked fibrin. When a detected value in the blood is below a positive threshold, it indicates that there is no thrombogenesis and thrombolysis in the body. AMI is caused by the occlusion of the coronary artery lumen by a thrombus. Since the arterial thrombus triggers platelet aggregation (white thrombus), the increase in D-dimer levels in the patient's body is less significant. In the case of AAD, the blood in the aortic lumen enters the middle layer of the aorta from transintimal tear, causing the media to be separated to form a thrombus, so the level of D-dimer in the body

generally increases. Once a thrombus is formed in the pulmonary artery of a patient with acute pulmonary embolism, it will stimulate a fibrinolytic system of an organism. As a result, the level of D-dimer in the patient's body will significantly increase within a short time. A D-dimer biomarker shows an increase in both acute aortic dissection and acute pulmonary embolism.

ST2 is a receptor for interleukin 33 (IL-33), including a soluble ST2 receptor (sST2) and a membrane-bound functional receptor (ST2L). The preliminary research results show that among patients with aortic dissection, compared with those with acute myocardial infarction, the sST2 level is higher in patients with acute aortic dissection within 24 hours of symptom onset; and compared with those with acute pulmonary embolism, the sST2 level is even higher in patients with acute aortic dissection, indicating that its diagnostic value is quite significant and can be used as an auxiliary indicator for aortic dissection.

Troponin (Tn), as a regulatory protein for muscle tissue contraction, is located on a thin filament of a contractile protein, and plays an important regulatory role in muscle contraction and relaxation. It contains three subtypes: a fast-reactive type, a slow-reactive type, and cardiac troponin (cTn). The former two are related to skeletal muscles, while cardiac troponin is only present in cardiomyocytes and is a complex composed of three subunits: cardiac troponin T (cTnT), cardiac troponin I (cTnI), and cardiac troponin C (cTnC). cTnT and cTnI are antigens specific to cardiomyocytes. cTnI has a molecular weight of about 23.88 KDa and is degraded from myocardial fibers when cardiomyocytes are injured. The increase of cTn in serum reflects an injury of cardiomyocytes. Its specificity and sensitivity are both higher than those of the previously commonly used myocardial enzyme spectrum. During myocardial infarction, due to occlusion or near occlusion of blood vessels, severe myocardial ischemia occurs, which in turn leads to the necrosis of cardiomyocytes. cTnI within cells is released into the blood, causing an increase of cTnI in the serum, which is a marker for the destruction of a myocardial structure and reflects the pathologically qualitative diagnosis.

Currently in clinical practice, the differential diagnosis of patients with acute fatal chest pain mainly relies on biomarkers known by patients, imaging findings, and pathogenesis characteristics, etc. Only D-dimer has clinical significance in the diagnosis of suspected patients with AAD. However, it can only be used for differential diagnosis of patients with acute myocardial infarction, but cannot distinguish patients with AAD from patients with pulmonary embolism. In addition, a large-scale instrument for detection needs to be used in a laboratory in the detection process. The entire detection process takes approximately 4 hours or more. The detection of other metabolites also needs to be carried out in the laboratory and is even more time-consuming. In addition, individual biomarkers can only reflect part of disease information from a single perspective and cannot comprehensively and accurately assess the causes, as well as pathological and

pathophysiological changes of acute chest pain and possibly accompanied dyspnea. Therefore, there is an urgent need for biomarkers that can provide additional information beyond the existing clinical diagnosis methods to assist in the differential diagnosis of patients with chest pain. In response to the urgent need for rapid differential diagnosis of population with acute chest pain, a new strategy for rapid differential diagnosis of acute fatal chest pain has been established, and a kit suitable for rapid diagnosis has been developed.

Summary of the Invention

Technical problem

The technical problem to be solved by the present invention is how to quickly identify a chest pain type of a patient with acute chest pain, in order to provide an effective treatment strategy.

Technical solution

To solve the aforementioned technical problem, the present invention provides a device for identifying or assisting in identifying an acute chest pain type.

The device for identifying or assisting in identifying the acute chest pain type provided by the present invention comprises the following modules:

M1, a data receiving module configured to receive a content of a protein in a serum of a test subject, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I, and the test subject is a patient with acute chest pain; and

M2, a result output module configured to output, from a computer, the acute chest pain type on the basis of a concentration of the protein.

The acute chest pain type may be acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, wherein the other type of acute chest pain may be acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

The soluble ST2 may be a protein having an amino acid sequence as shown by SEQ ID NO: 1 in a sequence listing. The cardiac troponin I may be a protein having an amino acid sequence as shown by SEQ ID NO: 2 in the sequence listing.

In the aforementioned device, the result output module comprises a model construction sub-module; and the model construction sub-module is used to construct a model by taking the concentration of the protein in the serum of a patient with acute chest pain as input data of the model and taking the acute chest pain type as output data.

The aforementioned device may be a computer device and comprises a memory, a processor, and a computer program that is stored in the memory.

The memory is used to store a program therein. Specifically, the program may comprise program

codes, which comprise computer program instructions.

The memory may comprise an internal storage and a non-volatile memory, and provide instructions and data to the processor.

The processor is used to read the corresponding computer program from the non-volatile memory into the internal storage and then run said program, forming a screening device for acute chest pain types at a logical level.

The processor is used to execute the computer program to implement the following steps:

N1, receiving data: receiving a content of a protein in the serum of a test subject, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I, and the test subject is a patient with acute chest pain; and

N2, outputting a result: outputting an acute chest pain type from a computer on the basis of a concentration of the protein.

The acute chest pain type may be acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, wherein the other type of acute chest pain may be acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

These computer program instructions may further be stored in a computer-readable memory that can guide a computer or other programmable data processing devices to work in a specific way, such that manufactured products including an instruction device may be created by the instructions stored in this computer-readable memory. This instruction device implements the functions designated in one or more processes in the flowcharts and/or in one or more blocks in the block diagrams.

The computer program instructions may also be loaded onto the computer or other programmable data processing devices, such that a series of operation steps are executed on the computer or other programmable devices to produce computer-implemented processing. Therefore, the instructions executed on the computer or other programmable devices provide steps for implementing the functions designated in one or more processes in the flowcharts and/or in one or more blocks in the block diagrams.

The present invention further provides a method for constructing a prediction model for an acute chest pain type. The method comprises: receiving a content of a protein in a serum of a patient with acute chest pain, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and constructing a prediction model for an acute chest pain type by taking the content of the protein as model input data and taking the acute chest pain type as output data.

The present invention further provides a method for identifying or assisting in identifying an acute

chest pain type. The method comprises: receiving a content of a protein in the serum of a patient with acute chest pain, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and outputting the acute chest pain type from a computer on the basis of a concentration of the protein, wherein the acute chest pain type is acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, and the other type of acute chest pain is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

In the aforementioned device, the method further comprises a step of constructing a model. The constructing the model comprises: receiving the content of soluble ST2, D-dimer and cardiac troponin I in the serum of a patient with acute chest pain as model input data; and constructing the prediction model for the acute chest pain type by means of using the model input data and by taking the acute chest pain type as output data.

The present invention further provides a computer program product or a computer-readable storage medium. The computer program product comprises a computer program. The computer-readable storage medium is used to store a computer program, wherein the computer program is executed by a processor to implement the steps of the aforementioned method for identifying or assisting in identifying an acute chest pain type.

The computer program product may be a software product that mainly implements its solutions through the computer program.

The computer-readable storage medium refers to a carrier for storing data and comprises both persistent and non-persistent and removable and non-removable media that may be implemented by any method or technology for storage of information. The information may be computer-readable instructions, data structures, program modules or other data. The computer-readable storage medium may be a magnetic tape, a magnetic disk, a floppy disk, an optical disk, a magneto-optical disk, ROM, PROM, VCD, DVD, a hard disk, a flash memory, a U disk, a CF card, an SD card, an MMC card, an SM card, a memory stick, or an xD card, etc.

The present invention further provides a product for identifying or assisting in identifying an acute chest pain type. Wherein the product comprises a device and a reagent, the device is the aforementioned device; the reagent is a protein and/or a substance for the detection of the protein; the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and the acute chest pain type is acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, wherein the other type of acute chest pain is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

The substance may comprise a substance for the detection of the content of a protein in the serum

by means of enzyme-linked immunosorbent assay, immunofluorescence assay, flow cytometry, radioimmunoassay, immunoprecipitation, immunoblotting, high-performance liquid chromatography, capillary gel electrophoresis, near-infrared spectroscopy, mass spectrometry, immunochemiluminescence, a colloidal gold immunoassay technology, a fluorescence immunochromatography technology, a surface plasmon resonance technology, an immuno-PCR technology, or a biotin-avidin technology.

The product may be a reagent and/or an instrument. The product may be a system.

The present invention further provides use of a protein in the preparation of a product for identifying or assisting in identifying an acute chest pain type, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and the acute chest pain type is acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, wherein the other type of acute chest pain is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

Use of a substance for the detection of the aforementioned protein in the preparation of a product for identifying or assisting in identifying an acute chest pain type also falls within the protection scope of the present invention.

In the aforementioned use, the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and the acute chest pain type is acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, wherein the other type of acute chest pain is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

The aforementioned use or method may be use or a method for non-disease diagnosis. The aforementioned use or method is not directly intended to obtain a disease diagnosis result or health status in a living human or animal body.

The aforementioned use or method may be use or a method for disease diagnosis.

The aforementioned use or method may be use or a method for a non-disease treatment purpose.

The aforementioned use or method is not intended to restore or gain health or reduce pain in a living human or animal body.

The aforementioned use or method may be use or a method for a disease treatment purpose.

Beneficial effects

According to the present invention, the product for differential diagnosis or assisting in differential diagnosis of a patient with acute chest pain can be prepared by combination of soluble ST2, D-dimer and cardiac troponin I in the serum as indicators for the differential diagnosis of acute chest pain. The differential diagnosis of a patient with acute chest pain can be performed by detecting soluble ST2, D-dimer and cardiac troponin I in the serum. The present invention can

improve the ability of differential diagnosis for acute chest pain based on known biomarkers, and is used in clinical practice to precisely stratify patient risks, thereby increasing survival rates of patients.

Brief Description of the Drawings

FIG. 1 is a computer flowchart of a method for identifying or assisting in identifying an acute chest pain type in the present invention.

FIG. 2 shows the content of three markers for patients in a discovery queue. A represents an sST2 level in the serum; B represents a D-dimer level in the serum; and C represents the comparison of cardiac troponin levels in the serum. The ordinate represents the sST2 level in the serum, the D-dimer level in the serum, and the cardiac troponin I level in the serum, respectively, in ng/mL.

Detailed Description of the Invention

The present invention is described in further detail below in conjunction with the specific embodiments, and the given examples are only for the purpose of clarifying the present invention, but not for the purpose of limiting the scope of the present invention. The examples provided below may be used as a guide for further improvement by a person of ordinary skill in the art and do not in any way constitute a limitation of the present invention.

The experimental methods in the following examples, unless otherwise specified, are conventional methods and are carried out in accordance with the techniques or conditions described in the literatures in the art or in accordance with the product instructions. The materials, reagents, etc. used in the following examples, unless otherwise specified, may be obtained commercially.

A serum soluble ST2 detection kit Human ST2/IL-33R in the following examples was purchased from R&D Corporation, with Catalog No. DY523B-05. An ACL TOP550CTS fully-automatic coagulation analyzer was used for D-dimer detection. A Beckman fully-automatic luminescence analyzer was used for cardiac troponin I. (The term "cardiac troponin" as mentioned below refers to "cardiac troponin I")

Stata/SE 15.1 statistical software was used in the following examples to process data. An experimental result of normally distributed continuous variables was expressed as mean $\pm$ standard deviation by using One-way ANOVA test. An experimental result of non-normally distributed continuous variables was expressed as a median (25%-75%) by using rank sum test. An experimental result of categorical variables was expressed by chi-square test. $P < 0.05$ (*) indicated a significant difference, $P < 0.01$ (**) indicated a very significant difference, and $P < 0.001$ (***) indicated a very significant difference.

The present invention first provides a method for identifying or assisting in identifying an acute

chest pain type (see FIG. 1). The method comprises the following steps:

Step S1: receiving the content of soluble ST2, D-dimer and cardiac troponin in the serum of a patient with a known type of acute chest pain to obtain model input data;

Step S2: constructing a multivariate logistic regression model by means of using the model input data;

Step S3: receiving the content of soluble ST2, D-dimer and cardiac troponin in the serum of a test subject to obtain subject data; and

Step S4: inputting the subject data into the multivariate logistic regression model, and outputting a prediction result of an acute chest pain type from a computer.

Example 1: Combined differential diagnosis of chest pain types by soluble ST2 (sST2), D-dimer and cardiac troponin

Ethical statement

An experimental protocol in this example of the present invention was approved by the Ethics Committee of Beijing Anzhen Hospital, Capital Medical University. The research was conducted in accordance with the principles of “Declaration of Helsinki”.

Research objects

All the research objects were adult individuals from China.

Diagnostic criteria for patients

The patients incorporated in the research needed to meet the following conditions.

Acute chest pain: the latest management consensus released by the European Society of Cardiology (ESC) and the Acute Cardiovascular Care Association (ACCA) in 2020 clearly stated that acute chest pain refers to non-traumatic pain or other chest discomfort that occurs within 24 hours of onset.

Acute myocardial infarction (abbreviated as AMI) means acute myocardial injury [an increase or decrease of cardiac troponin (cTn) in the serum at least once exceeds an upper limit (a 99th percentile value of an upper limit of a reference range) of a normal value], along with clinical evidences of acute myocardial ischemia, including: (1) acute myocardial ischemia symptoms; (2) new ischemic electrocardiogram changes; (3) new pathological Q waves; (4) new imaging evidences of loss of viable myocardium or segmental movement abnormalities of the ventricular wall; and (5) coronary artery thrombosis confirmed by coronary angiography or intraluminal imaging examination or autopsy.

Acute aortic dissection (abbreviated as AAD) means tearing of the intima and media of the aorta caused by various reasons, where the intima of the aorta is separated from the media, and the blood flows in, resulting in the aortic lumen being partitioned into a true lumen and a false lumen. The onset time of less than or equal to 2 weeks means an acute phase.

Acute pulmonary embolism (abbreviated as APE) is a clinical syndrome caused by the occlusion of pulmonary arteries by endogenous or exogenous emboli, resulting in pulmonary circulation and right heart dysfunctions.

The other type of acute chest pain suffered by the patient is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction, including unstable angina, chest pain symptoms or other diseases. Diagnostic criteria for unstable angina: a group of clinical angina syndromes between stable angina and acute myocardial infarction.

Discovery queue: a total of 326 patients with acute chest pain were included, wherein an average age of 326 patients was 53 years old, and 219 males were included, accounting for 68.4%. The baseline characteristics of this discovery queue were stratified by disease types, as detailed in Table 1. Among 326 patients, there were 109 patients with AAD, 72 patients with AMI, 24 patients with APE, and 121 patients with other type of acute chest pain. Among 109 patients with AD, the average age was 51 years old, 68.9% of the patients were male, the median body mass index (BMI) was 26.6, the median left ventricular ejection fraction (LVEF) was 63.0%, and 69.4% of the patients had high blood pressure (HBP), while 3.5% had diabetes mellitus (DM). Among 72 patients with AMI, the average age was 54 years old, 84.7% of the patients were male, the median BMI was 25.8, the median LVEF was 55.0%, and 59.4% of the patients had high blood pressure, while 26.1% had diabetes mellitus. Among 24 patients with acute pulmonary embolism (APE), the average age was 62 years old, 50% of the patients were male, the median BMI was 23.8, the median LVEF was 62.0%, and 58.3% of the patients had high blood pressure, while 20.8% had diabetes mellitus. There were 121 patients with other type of acute chest pain, an average age was 53 years old, and 62.0% of the patients were male.

Table 1: Statistical information on patients with acute chest pain in a discovery queue

	326 patients with acute chest pain	109 patients with AAD	72 patients with AMI	24 patients with APE	121 patients with other type of acute chest pain	P
Age(years)	53.1±11.9	50.8±11.7	53.8±11.4	62.4±9.6	52.7±12.0	<0.001
Male(%)	219(68.4)	71(68.9)	61(84.7)	12(50.0)	75(62.0)	0.002
BMI(Kg/M ²)	26.3(24.6-29.3)	26.6(24.5-28.7)	25.8(22.7-29.4)	23.8(23.7-29.3)	27.1(25.7-29.4)	0.487
LVEF	60.0(55.0-65.0)	63.0(60.0-68.0)	55.0(45.0-60.0)	62.0(60.0-66.0)	67.5(62.5-68.0)	<0.001
HBP	131(63.0)	59(69.4)	41(59.4)	14(58.3)	17(56.7)	0.454
DM	33(15.8)	3(3.5)	18(26.1)	5(20.8)	7(23.3)	0.001
gST2 concentration(ng/ml)	29.2(15.9-54.5)	80.0(49.2-143.8)	25.0(15.5-37.2)	14.9(10.2-30.1)	19.1(11.8-26.1)	<0.001

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D-dimer concentration(ng/m L)	156.0 (61.0-1073.0)	1356.0(866.0-2406.5)	71.5(52.5-126.0)	2393.5(1373.0-2990.5)	75.0(45.0-186.0)	<0.001
Cardiac troponin concentration(ng/m L)	0.02(0-0.18)	0.03(0.01-0.08)	0.66(0-13-3.88)	0.02(0.01-0.09)	0(0-0.01)	<0.001

Discovery queue: a total of 217 patients with acute chest pain were included, wherein an average age of 217 patients was 53 years old, and 163 males were included, accounting for 75.1%. The baseline characteristics of this discovery queue were stratified by disease types, as detailed in Table 2. Among 217 patients, there were 120 patients with AAD, 70 patients with AMI, and 27 patients with APE. Among 120 AD patients, the average age was 48 years old, 77.5% of the patients were male, the median BMI was 26.1, the median LVEF was 63.0%, and 76.7% of the patients had high blood pressure, while 8.3% had diabetes mellitus. Among 70 patients with AMI, the average age was 57 years old, 85.7% of the patients were male, and 58.6% of the patients had high blood pressure, while 28.6% had diabetes mellitus. Among 27 patients with APE, the average age was 66 years old, 37.0% of the patients were male, and 59.3% of the patients had high blood pressure, while 14.8% had diabetes mellitus.

Table 2: Statistical information on patients with acute chest pain in a validation queue

	217 patients with acute chest pain	120 patients with AAD	70 patients with AMI	27 patients with APE	P
Age(years)	53.1±13.0	47.8±11.2	57.1±10.3	65.7±14.5	<0.001
Male(%)	163(75.1)	93(77.5)	60(85.7)	10(37.0)	<0.001
HBP	149(68.7)	92(76.7)	41(58.6)	16(59.3)	0.018
DM	34(15.7)	10(8.3)	20(28.6)	4(14.8)	0.001
sST2 concentration(ng/mL)	32.6(15.2-85.9)	72.5(39.2-138.1)	15.4(10.8-25.3)	10.7(7.4-19.1)	<0.001
D-dimer concentration(ng/mL)	963.0(131.0-1992.0)	1470.5(944.5-2651.5)	91.5(57.0-131.0)	1259.0(937.0-2318.0)	<0.001
Cardiac troponin concentration(ng/mL)	0.07(0.01-0.85)	0.02(0.01-0.34)	0.67(0.11-2.45)	0.04(0.01-0.19)	<0.001

I. Detection of the content of soluble ST2, D-dimer and cardiac troponin in the serum

Serum sample processing: the blood was collected and centrifuged at 4°C and 1200 rpm for 10 minutes, and the centrifuged supernatant was collected for testing.

1. Detection of soluble ST2 in the serum

Detection kit: Human ST2/IL-33R DuoSet (R&D, Catalog No. DY523B-05). The detection steps for serum sST2 by an ELISA method were carried out with reference to instructions in the kit.

2. Detection of D-dimer in the serum

Detection kit: Catalog No. REV202209, Instrument Laboratory Company. The ACL TOP550CTS fully-automatic coagulation analyzer was used, and the detection steps for D-dimer levels in the serum were carried out in accordance with instructions in the kit.

3. Detection of cardiac troponin I in the serum

Detection kit: Catalog No. B52699, manufactured by Immunotech SAS. The Beckman fully-automatic luminescence analyzer was used, and the detection steps for the cardiac troponin level in the serum were carried out in accordance with instructions in the kit.

II. Analysis of data results of individual markers for soluble ST2, D-dimer and cardiac troponin levels of samples in a discovery queue

The results were shown in FIG. 2 (A, B and C) and Table 1: compared with other type of chest pain (other than AAD), the sST2 level in the serum of a patient with AAD was significantly increased, being 80.0 (median, IQR 49.2-143.8) ($P < 0.001$).

Compared with other type of chest pain (other than APE), the D-dimer level in the serum of a patient with APE was significantly increased, being 2394 (median, IQR 1373-2991) ($P < 0.001$).

Compared with other type of chest pain (other than AMI), the cTNI level in the serum of a patient with AMI was significantly increased, being 0.66 (median, IQR 0.13-3.88) ($P < 0.001$).

III. Combined differential diagnosis of different types of chest pain by three markers - soluble ST2, D-dimer and cardiac troponin

To achieve the optimal combination of three biomarkers - soluble ST2, D-dimer and cardiac troponin, a multivariate logistic regression model was constructed using different variable combinations (random combinations of the three biomarkers - soluble ST2, D-dimer, and/or cardiac troponin). A data processing and analysis method was as follows: data was processed using Stata/SE 15.1 statistical software. In the presence of multiple predictive variables, the multivariate logistic regression model was adopted. AUC was calculated based on a prediction probability generated by the multivariate logistic regression model. A cutoff value for the combined diagnosis by ST2, D-dimer and cardiac troponin was derived as an optimal threshold through calculation of a Youden index (Youden index = sensitivity + specificity - 1).

The results were as follows: the combination of soluble ST2, D-dimer and cardiac troponin performed best in terms of diagnostic performance; in the aforementioned discovery queue, AUC (0.9813) in combined diagnosis of ADD by soluble ST2, D-dimer and cardiac troponin was higher than that in respective diagnosis by a single marker, with a sensitivity of 98.06% and a specificity of 90.19%; AUC (0.9054) in combined diagnosis of AMI by soluble ST2, D-dimer and cardiac

troponin was higher than that in respective diagnosis by a single marker, with a sensitivity of 76.39% and a specificity of 91.43%; and AUC (0.9554) in combined diagnosis of APE by soluble ST2, D-dimer and cardiac troponin was higher than that in respective diagnosis by a single marker, with a sensitivity of 91.30% and a specificity of 90.11% (Table 3).

Table 3: ROC curve information of patients with various types of acute chest pain in individual or combined diagnosis by sST2, D-Dimer and cTNI in a discovery queue

Acute chest pain type	Markers	AUC	Sensitivity	Specificity	Threshold(cutoff)
AAD versus other type of chest pain	sST2	0.9663	99.03%	84.79%	34.58
	D-Dimer	0.8888	97.22%	78.80%	324
	cTNI	0.5082	80.58%	39.72%	0.01
	sST2+D-Dimer+cTNI	0.9813	98.06%	90.19%	0.1609
AMI versus other type of chest pain	sST2	0.4175	100.00%	8.06%	8.93
	D-Dimer	0.2469	97.22%	2.82%	27
	cTNI	0.8985	93.06%	70.20%	0.04
	sST2+D-Dimer+cTNI	0.9054	76.39%	91.43%	0.3139
APE versus other type of chest pain	sST2	0.3025	100.00%	3.04%	6.94
	D-Dimer	0.8981	100.00%	9.81%	495
	cTNI	0.5338	91.30%	35.03%	0.01
	sST2+D-Dimer+cTNI	0.9554	91.30%	90.11%	0.0725

IV. Classification of different types of acute chest pain by combination of biomarkers - soluble ST2, D-dimer and cardiac troponin

It was found by combined diagnosis of markers in the discovery queue - soluble ST2, D-dimer and cardiac troponin (Table 4): when the content of sST2 was ≥ 34.6 ng/mL, a diagnostic rate of acute aortic dissection was 92.7%; when the content of cTNI was ≥ 0.04 ng/mL, a diagnosis rate of acute myocardial infarction was 93.1%; and when the content of sST2 was < 34.6 ng/mL and the content of D-Dimer was ≥ 500 ng/mL, a diagnostic rate of acute pulmonary embolism was 87.5%.

Table 4: Statistical data on the classification of different types of chest pain by markers in a discovery queue

Different types of chest pain were classified according to sST2&D-Dimer&cTNI levels by combination of markers	109 patients with AAD	72 patients with AMI	24 patients with APE
sST2 ≥ 34.6 ng/mL, D-Dimer-, cTNI-	101(92.7%)	23(31.9%)	3(12.5%)
sST2-, D-Dimer-, cTNI ≥ 0.04 ng/mL	42(38.5%)	67(93.1%)	0
sST2 < 34.6 ng/mL, D-Dimer ≥ 500 ng/mL, cTNI-	1(0.9%)	1(1.4%)	21(87.5%)

In summary, the prediction model for different types of acute chest pain was constructed by combination of soluble ST2, D-dimer and cardiac troponin in the follow ways:

- 1) when the content of sST2 was ≥ 34.6 ng/mL, it assists in identifying the chest pain type as acute

aortic dissection;

2) when the content of cTNI was ≥ 0.04 ng/mL, it assists in identifying the chest pain as acute myocardial infarction;

3) when the content of sST2 was < 34.6 ng/mL and the content of D-Dimer was ≥ 500 ng/mL, it assists in identifying the chest pain type as acute pulmonary embolism; and

4) when the content of sST2 was < 34.6 ng/mL, the content of D-Dimer was < 500 ng/mL, and the content of TNI was < 0.04 ng/mL, it assists in identifying the chest pain type as other type of chest pain other than the above three types of acute fatal chest pain.

This prediction model was then validated in a validation queue.

Example 2: Use of combined soluble ST2, D-dimer and cardiac troponin in the prediction model of chest pain type

The content of soluble ST2, D-dimer and cardiac troponin in the serum of samples in the validation queue were detected according to the detection method described in Example 1 (see Table 7 for specific data), and then the prediction model in Example 1 was used to perform multivariate logistic regression on the validation queue.

The results were as follows: in Table 5, sST2 represented the diagnosis by sST2 alone, and sST2+D-Dimer+cTNI represented combined diagnosis by these three proteins - soluble ST2, D-dimer and cardiac troponin. In the validation queue, AUC (0.9534) in combined diagnosis of ADD by these three proteins - soluble ST2, D-dimer and cardiac troponin was higher than that in respective diagnosis by a single marker, with a sensitivity of 93.33% and a specificity of 84.54%; AUC (0.9849) in combined diagnosis of these three proteins - AMI by soluble ST2, D-dimer and cardiac troponin was higher than that in respective diagnosis by a single marker, with a sensitivity of 97.14% and a specificity of 96.60%; and AUC (0.9076) in combined diagnosis of APE by soluble ST2, D-dimer and cardiac troponin was higher than that in respective diagnosis by a single marker, with a sensitivity of 92.59% and a specificity of 86.84% (Table 5).

Table 5: ROC curve information of patients with various types of acute chest pain in individual or combined diagnosis by sST2, D-Dimer and cTNI in a validation queue

Acute chest pain type	Markers	AUC	Sensitivity	Specificity	Threshold(cutoff)
AAD versus other type of chest pain	sST2	0.9302	82.50%	92.78%	34.73%
	D-Dimer	0.8446	95.00%	69.07%	391
	cTNI	0.3061	100.00%	0.00%	0
	sST2+D-Dimer+cTNI	0.9534	93.33%	84.54%	0.3889
AMI versus other type of chest pain	sST2	0.1765	100.00%	0.00%	4.60
	D-Dimer	0.0267	100.00%	0.00%	11
	cTNI	0.7730	88.57%	54.42%	0.04
	sST2+D-Dimer+cTNI	0.9849	97.14%	96.60%	0.3690

APE versus other type of chest pain	sST2	0.1728	100.00%	0.53%	5.22
	D-Dimer	0.6673	88.89%	41.58%	500
	cTNI	0.3924	81.48%	16.32%	0.01
	sST2+D-Dimer+cTNI	0.9076	92.59%	86.84%	0.1838

When the content of sST2 was ≥ 34.6 ng/mL, the chest pain was diagnosed as acute aortic dissection; when the content of cTNI was ≥ 0.04 ng/mL, the chest pain was diagnosed as acute myocardial infarction; and when the content of sST2 was < 34.6 ng/mL and the content of D-Dimer was ≥ 500 ng/mL, the chest pain was diagnosed as acute pulmonary embolism.

It was found by combined diagnosis of markers in the validation queue - soluble ST2, D-dimer, and cardiac troponin (Table 6 and Table 7): when the content of sST2 was ≥ 34.6 ng/mL, a diagnostic rate of acute aortic dissection was 82.50%; when the content of cTNI was ≥ 0.04 ng/mL, a diagnosis rate of acute myocardial infarction was 88.57%; and when the content of sST2 was < 34.6 ng/mL and the content of D-Dimer was ≥ 500 ng/mL, a diagnostic rate of acute pulmonary embolism was 85.19%.

Table 6: Statistical data on the classification of different types of chest pain by combination of markers in a validation queue

Different types of chest pain were classified according to sST2&D-Dimer&cTNI levels by combination of markers	120 patients with AAD	70 patients with AMI	27 patients with APE
sST2 ≥ 34.6 ng/mL, D-Dimer-, cTNI-	99(82.50%)	6(8.57%)	1(3.70%)
sST2-, D-Dimer-, cTNI ≥ 0.04 ng/mL	52(43.33%)	62(88.57%)	15(55.56%)
sST2 < 34.6 ng/mL, D-Dimer ≥ 500 ng/mL, cTNI-	20(16.67%)	3(4.29%)	23(85.19%)

Table 7. Detection results of soluble ST2, D-dimer and cardiac troponin levels in the serum of patients in a validation queue

Patent Nos.	Soluble ST2 concentration(ng/mL)	D-dimer concentration(ng/mL)	Cardiac troponin concentration(ng/mL)	Determination results of chest pain types
1	8.13613779	999	0	AAD
2	71.2574198	3219	0.53	AAD
3	11.8277482	1984	0	AAD
4	44.5050741	3244	0	AAD
5	147.15864	2233	0.01	AAD
6	66.816279	3041	0.05	AAD
7	136.528128	2507	0.12	AAD
8	153.020456	2999	0.03	AAD
9	159.434898	2561	0.1	AAD
10	162.758493	1099	10.96	AAD
11	33.9149044	1135	0.01	AAD

12	44.1538923	1568	0.01	AAD
13	50.6696311	947	0.01	AAD
14	28.1809129	1025	0	AAD
15	75.9797134	606	0.01	AAD
16	38.6482247	3082	0	AAD
17	120.556201	3599	0.06	AAD
18	61.7205173	3051	0.01	AAD
19	126.056353	2210	0.01	AAD
20	31.4281178	1067	0.01	AAD
21	49.9216734	3230	0	AAD
22	31.8591489	2365	0	AAD
23	103.06455	3327	0.01	AAD
24	38.5546901	500	0.35	AAD
25	78.1765625	1152	0.51	AAD
26	24.537785	3168	0.02	AAD
27	18.5739162	3144	0.01	AAD
28	135.095946	2786	0.35	AAD
29	47.3003274	3220	0.01	AAD
30	89.1315314	1760	0.01	AAD
31	96.7264371	1979	0	AAD
32	14.711644	1028	0	AAD
33	58.0426784	3081	0	AAD
34	98.1036596	3328	4.29	AAD
35	36.3854394	443	0.01	AAD
36	105.445272	2472	0.04	AAD
37	58.275625	2009	0.02	AAD
38	79.9837983	1037	0.21	AAD
39	43.6567732	1981	0.01	AAD
40	58.4507198	837	0.05	AAD
41	98.5376265	1659	0.09	AAD
42	49.9216734	624	0.03	AAD
43	34.7602901	1032	0	AAD
44	54.0586395	2170	0.01	AAD
45	150.724963	837	0.48	AAD
46	137.009145	3169	0.01	AAD
47	16.3917305	68	0.03	AAD
48	131.664648	1832	0.21	AAD
49	85.9369719	3409	0.03	AAD
50	39.8309546	3291	0	AAD
51	37.3012633	417	0.01	AAD
52	22.673578	1777	0.37	AMI
53	17.6252154	49	0.6	AMI
54	50.7279831	63	0.08	AMI

55	26.528545	529	0.64	AMI
56	70.6448944	959	0.01	AAD
57	56.1822426	1282	0.01	AAD
58	23.2512254	3412	0	AAD
59	14.2237906	76	0.37	AMI
60	18.3895797	123	17.7	AMI
61	8.21382615	7166	0.31	APE
62	14.884947	94	0.09	AMI
63	26.1111789	126	0.62	AMI
64	6.7473976	900	0.01	APE
65	15.6596533	57	0.11	AMI
66	16.1400673	1899	0	AAD
67	28.526702	1829	0	AAD
68	22.1926546	1820	0.04	APE
69	153.714914	98	0.03	AAD
70	25.7806805	1062	0.05	AAD
71	28.8233607	168	0.77	AMI
72	17.7281776	252	0.35	AMI
73	10.1601644	2318	0.01	APE
74	55.6532874	216	0	AAD
75	210.556547	778	0	AAD
76	26.5939638	105	0.47	AMI
77	8.16383043	1117	0.01	APE
78	12.3024385	181	0.34	AMI
79	5.58680841	2896	0.25	APE
80	4.59742635	44	2.8	AMI
81	5.53462797	135	0.07	AMI
82	5.70902094	1387	0.08	AMI
83	6.26042536	3462	0	AAD
84	22.3453239	126	0.35	AMI
85	14.3165257	64	0.75	AMI
86	8.91253073	126	0.21	AMI
87	36.1991639	61	0.3	AMI
88	112.762788	2836	0.03	AAD
89	13.6332746	99	0.04	AMI
90	32.6312378	226	40.81	AMI
91	17.888459	36	0.01	AMI
92	34.7355295	513	0	AAD
93	23.4930265	260	4.19	AMI
94	29.3746863	41	0.59	AMI
95	14.2830664	1189	0.09	APE
96	12.3346851	937	0.05	APE
97	14.009535	101	0.01	AMI

98	23.3170894	109	0.07	AMI
99	46.4304164	468	0	AAD
100	127.885339	1038	0.06	AAD
101	11.640314	77	0.28	AMI
102	9.9414733	76	0.01	AMI
103	46.247955	67	1.97	AMI
104	46.2823003	2713	0.12	AAD
105	10.7919832	131	0.21	AMI
106	34.1066792	57	0.68	AMI
107	9.93884908	425	1.21	AMI
108	21.3734634	2958	0.98	APE
109	12.3873205	365	0.03	AMI
110	5.21651666	1259	0.02	APE
111	36.1253807	1745	0.01	AAD
112	59.4563938	820	0.02	AAD
113	28.1883007	2142	0.01	AAD
114	31.0072788	95	6.09	AMI
115	16.3361884	85	0.05	AMI
116	15.2004558	258	0.19	AMI
117	6.84242276	293	0.85	AMI
118	139.250902	1987	0.05	AAD
119	203.641787	191	0.04	AAD
120	76.2972283	2327	0.01	AAD
121	23.4549768	94	0.01	AMI
122	15.5518068	57	0.34	AMI
123	5.83357151	799	0	APE
124	9.81206512	37	0.94	AMI
125	15.2509874	55	1.04	AMI
126	14.5206321	40	1.95	AMI
127	10.7534611	102	102	AMI
128	16.1571995	138	2.49	AMI
129	28.6969637	79	2.45	AMI
130	11.2434075	114	0	AMI
131	9.59034769	162	1.37	AMI
132	46.9201013	160	10.54	AMI
133	64.2310903	106	12.84	AMI
134	41.4447243	40	0.88	AMI
135	26.8370264	56	0.09	AMI
136	19.1271441	2226	0.02	APE
137	27.461448	537	0	AAD
138	142.850527	1126	0.01	AAD
139	15.8804698	106	0.03	AMI
140	23.9982581	646	0.82	AAD

141	13.7968962	43	2.31	AMI
142	12.0769825	51	2.16	AMI
143	12.1735492	65	0.09	AMI
144	181.33494	1142	0	AAD
145	21.5442241	82	49.44	AMI
146	25.3161942	197	95	AMI
147	113.152006	1171	0	AAD
148	29.965132	1064	2.4	AAD
149	30.5046536	755	8.62	AAD
150	7.44136357	964	0	APE
151	5.52084863	29	5.86	AMI
152	132.88026	940	8.87	AAD
153	267.299521	2663	2.31	AAD
154	13.6332746	67	95	AMI
155	177.034102	2825	1.28	AAD
156	56.9826006	1203	6.29	AAD
157	35.1842544	424	0	AAD
158	17.1779997	127	1.42	AMI
159	6.35968184	61	1.93	AMI
160	107.959852	898	0	AAD
161	13.2418142	28	0.65	AMI
162	10.6057554	53	23.82	AMI
163	18.3891606	126	7.23	AMI
164	28.4591766	47	4.06	AMI
165	2123.04927	2397	0.07	AAD
166	231.067764	3019	3.76	AAD
167	8.85956117	60	1.43	AMI
168	8.70451481	48	0.81	AMI
169	68.7723167	2892	14.05	AAD
170	213.41559	1186	4.04	AAD
171	7.89159191	89	0	AMI
172	301.127705	2344	0.58	AAD
173	127.28374	963	0.21	AAD
174	124.484545	295	1.24	AAD
175	205.140867	1221	0.12	AAD
176	7.40955815	11	5.04	AMI
177	275.397875	2977	0.05	AAD
178	62.7979097	2559	0.01	AAD
179	99.5738634	1566	0.02	AAD
180	148.270735	1013	4.13	AAD
181	145.641536	1006	0.01	AAD
182	2275.91016	236	0.02	AAD
183	134.892303	926	0	AAD

184	18.0740115	1992	0.01	AAD
185	61.5311332	3111	4.2	AAD
186	410.0064	457	1.05	AAD
187	43.348284	671	0.31	AAD
188	73.6750206	747	0	AAD
189	80.5042	391	4.1	AAD
190	47.4138043	942	0.01	AAD
191	219.615911	1045	13.57	AAD
192	167.298938	1618	22.38	AAD
193	39.7703115	1007	7.35	AAD
194	51.7682754	952	0	AAD
195	180.071571	1375	0.04	AAD
196	155.638763	2165	0.32	AAD
197	133.763776	3290	0.09	AAD
198	202.175092	2640	0.01	AAD
199	188.517775	1063	0.67	AAD
200	208.350939	1124	102	AAD
201	123.269025	3075	5.93	AAD
202	37.7168	679	0	AAD
203	42.4146233	1947	1.15	AAD
204	17.6792687	2655	0.19	APE
205	7.4910532	1594	0.36	APE
206	10.73307	239	0.04	APE
207	28.9077975	1583	0.25	APE
208	26.2716168	5878	0.02	APE
209	11.4352706	417	0	APE
210	203.390836	2119	0.04	APE
211	17.6252154	618	1.35	APE
212	26.9589809	1583	0.05	APE
213	16.4279309	1139	0	APE
214	7.36686274	1074	0.03	APE
215	7.44292572	454	0	APE
216	5.23872438	1251	0.13	APE
217	9.30752353	2733	0.07	APE

In summary, by rapid detection of the content of the three biomarkers - sST2, D-dimer and cardiac troponin, the levels of the three markers were conjointly analyzed: when the content of sST2 was ≥ 34.6 ng/mL, it assists in identifying the chest pain as acute aortic dissection; when content of cTNI was ≥ 0.04 ng/mL, it assists in identifying the chest pain as acute myocardial infarction; when the content of sST2 was < 34.6 ng/mL and the content of D-Dimer was ≥ 500 ng/mL, it assists in identifying the chest pain as acute pulmonary embolism; and when the content of sST2 was < 34.6 ng/mL, the content of D-Dimer was < 500 ng/mL, and the content of cTNI was < 0.04

ng/mL, it assists in identifying the chest pain as chest pain other than the above three types of acute fatal chest pain. By improving the ability of differential diagnosis for patients with acute fatal chest pain, the risks of patients were accurately stratified, in order to increase the survival rate of patients in clinical practice.

The above provides a detailed description of the present invention. For a person skilled in the art, the present invention may be implemented within a wide range under the same parameters, concentrations and conditions without departing from the purpose and scope of the present invention and without unnecessary experiments. Although special examples are given in the present invention, it should be understood that further improvements may be made to the present invention. In summary, according to the principles of the present invention, the present application is intended to include any change, use or improvement of the present invention, including changes that deviate from the scope disclosed in the present application and are made by conventional technologies known in the art.

Cross-reference to Related Application

This application claims priority to Chinese Patent Application No. 202410062876.2, filed on January 17, 2024 to CNIPA and entitled "DEVICE FOR IDENTIFICATION OR AUXILIARY IDENTIFICATION OF ACUTE CHEST PAIN TYPE AND USE THEREOF", the disclosure of which is herein incorporated by reference in its entirety.

Industrial Applicability

According to the present invention, the product for differential diagnosis or assisting in differential diagnosis of a patient with acute chest pain by combination of soluble ST2, D-dimer and cardiac troponin I in the serum as indicators for the differential diagnosis of acute chest pain. The differential diagnosis of a patient with acute chest pain can be performed by detecting soluble ST2, D-dimer and cardiac troponin I in the serum. The present invention can improve the ability of differential diagnosis for acute chest pain based on known biomarkers, and is used in clinical practice to precisely stratify patient risks, thereby increasing survival rates of patients.

Sequence listing

SEQ ID No. 1

MGFWILAILTILMYSTAAKFSKQSWGLENEALIVRCPRQGKPSYTVDWYYSQTNKSIPTQE
RNRVFASGQLLKFLPAAVADSGIYTCIVRSPTFNRTGYANVTIYKKQSDCNVPDYLMYSTV
SGSEKNSKIYCPTIDLYNWTAPLEWFKNCQALQGSRYRAHKSFLVIDNVMTEDAGDYTCK
FIHNENGANYSVTATRSFTVKDEQGFSLFPVIGAPAQNEIKEVEIGKNANLTCSACFGKGTQ
FLAAVLWQLNGTKITDFGEPRIQQEEGQNQSFSNGLACLDMVLRIADVKEEDLLLQYDCL
ALNLHGLRRHTVRLSRKNPSKECF.

SEQ ID No. 2

MSDIEEVVEEYEEEEQEEAAVEEEEDWREDEDEQEEAAEEDAEAEAETEETRAEEDDEEEE
EAKEAEDGPMEESEKPKPRSFMPNLVPPKIPDGERVDFDDIHRKRMEKDLNELQALIEAHFE
NRKKEEEEELVSLKDRIERRRAERAEEQQRIRNEREKERQNRLAEERARREEEENRRKAEDE
ARKKKALSNNMMHFGGYIQKTERKSGKRQTEREKKKKILAERRKVLAIIDLHNLNEDQLREKA
KELWQSIYNLEAEKFDLQEKFKQQKYEINVLRNRINDNQKVSKTRGKAKVTGRWK.

Claims

1. A device for identifying or assisting in identifying an acute chest pain type, wherein the device comprises the following modules:

M1, a data receiving module configured to receive a content of a protein in a serum of a test subject, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I, and the test subject is a patient with acute chest pain; and

M2, a result output module configured to output, from a computer, the acute chest paintype on the basis of a concentration of the protein; wherein

the acute chest pain type is acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, wherein the other type of acute chest pain is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

2. The device according to claim 1, wherein the result output module comprises a model construction sub-module; and the model construction sub-module is used to construct a model by taking the concentration of the protein in the serum of a patient with acute chest pain as input data of the model and taking the acute chest pain type as output data.

3. A method for identifying or assisting in identifying an acute chest pain type, wherein the method comprises: receiving a content of a protein in a serum of a patient with acute chest pain, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and constructing a prediction model for an acute chest pain type by taking the content of the protein as model input data and taking the acute chest pain type as output data.

4. A method for identifying or assisting in identifying an acute chest pain type, wherein the method comprises: receiving a content of a protein in the serum of a patient with acute chest pain, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and outputting the acute chest pain type from a computer on the basis of a concentration of the protein, wherein the acute chest pain type is acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, and the other type of acute chest pain is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

5. The method according to claim 4, wherein the method comprises: constructing a model, wherein the constructing the model comprises: receiving the content of soluble ST2, D-dimer and cardiac troponin I in the serum of a patient with acute chest pain as model input data; and constructing the prediction model for the acute chest pain type by means of using the model input

data and by taking the acute chest pain type as output data.

6. A computer-readable storage medium storing a computer program, wherein the computer program causes a computer to execute the steps of the method according to any one of claims 3 to 5.

7. A product for identifying or assisting in identifying an acute chest pain type, wherein the product comprises a device and a reagent, the device is the device according to claim 1 or 2; the reagent is a protein and/or a substance for the detection of the protein; the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and the acute chest pain type is acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, wherein the other type of acute chest pain is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

8. Use of a protein in the preparation of a product for identifying or assisting in identifying an acute chest pain type, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and the acute chest pain type is acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, wherein the other type of acute chest pain is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.

9. Use of a substance for the detection of a protein in the preparation of a product for identifying or assisting in identifying an acute chest pain type, wherein the protein is selected from the group consisting of soluble ST2, D-dimer and cardiac troponin I; and the acute chest pain type is acute aortic dissection, acute myocardial infarction, acute pulmonary embolism or other type of acute chest pain, wherein the other type of acute chest pain is acute chest pain other than acute aortic dissection, acute myocardial infarction and acute myocardial infarction.