(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 691 683 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
31.12.2014 Bulletin 2015/01

(21) Application number: **04702945.9**

(22) Date of filing: **16.01.2004**

(51) Int Cl.:
A61B 5/0464 *(2006.01)*

(86) International application number:
PCT/US2004/001107

(87) International publication number:
WO 2005/060829 (07.07.2005 Gazette 2005/27)

(54) **SYSTEM AND METHOD FOR PROCESSING AND PRESENTING ARRHYTHMIA INFORMATION TO FACILITATE HEART ARRHYTHMIA IDENTIFICATION AND TREATMENT**

SYSTEM UND VERFAHREN ZUR BEARBEITUNG UND DARSTELLUNG VON ARRHYTHMIE-INFORMATIONEN ZUR ERLEICHTERUNG DER IDENTIFIZIERUNG UND BEHANDLUNG VON HERZARRHYTHMIE

SYSTEME ET PROCEDE DE TRAITEMENT ET DE PRESENTATION D'INFORMATIONS ARYTHMIQUES AFIN DE FACILITER L'IDENTIFICATION ET LE TRAITEMENT D'ARYTHMIES CARDIAQUES

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

(30) Priority: **26.11.2003 US 525386 P**

(43) Date of publication of application:
23.08.2006 Bulletin 2006/34

(73) Proprietor: **CardioNet, Inc.**
Conshohocken, PA 19428 (US)

(72) Inventors:
- **PRYSTOWSKY, Eric, N.**
  Carmel, IN 46032 (US)
- **KORZINOV, Lev**
  San Diego, CA 92037 (US)
- **BAUMANN, Eric**
  San Diego, CA 92129 (US)
- **DENIS, Scott**
  Murrieta, CA 92563 (US)
- **JAIME, Manuel, E.**
  Solana Beach, CA 92075 (US)
- **JAMES, Justin**
  San Diego, CA 92130 (US)

(74) Representative: **Curran, Clair et al**
Ropes & Gray International LLP
5 New Street Square
London EC4A 3BF (GB)

(56) References cited:
WO-A1-02/24276 **WO-A2-01/76461**
US-A- 5 676 153 **US-B1- 6 246 907**
US-B1- 6 609 023

EP 1 691 683 B1

Description

[0001] The present application describes systems and techniques relating to processing and presenting arrhythmia event information from physiological data, for example, selectively presenting atrial fibrillation events to a medical practitioner.

[0002] Over the years, various devices have been used for monitoring hearts in living beings. Additionally, systems have been used to collect and report on heart information obtained from patients.

[0003] A method according to the preamble of claim 1 is known from wo 02/24276.

SUMMARY

[0004] In general, in one aspect, a heart monitoring system collects heart data from a monitored individual and stores the data at a monitoring center. Collected data can be processed, and graphical representations of the collected information can be presented to medical practitioners to assist in treating heart arrhythmias, such as atrial fibrillation. A system and method can involve operations including identifying arrhythmia events in physiological data obtained for a living being, receiving human assessments of at least a portion of the arrhythmia events, determining a measure of correlation between the human assessments and the identified events, and selectively presenting information regarding the identified events based on the measure of correlation. The operations also can include identifying atrial fibrillation events in physiological data obtained for a living being, obtaining heart rate data for the living being, and presenting information regarding the heart rate data and duration of the atrial fibrillation events together with a common time scale to pictographically represent heart rate trend with atrial fibrillation burden during a defined time period.

[0005] One or more of the following advantages can be realized. The heart monitor can loop every twenty-four hours and can automatically transmit heart data at least every twenty-four hours. The system can automatically generate a daily graphical summary of atrial fibrillation (AF) burden for review by a medical practitioner, which can be presented effectively anywhere using one or more communication networks. The AF burden graph can be used for asymptomatic AF detection, drug therapy (rate, rhythm, anti-coagulants), pre/post ablation monitoring, and CHF (congestive heart failure) decompensation. The system can provide an overall sensitivity of 96%, a positive predictivity of over 99%, and artifact rejection of over 90%. In one implementation, the graph only displays events where AF detection is validated by a technician finding AF in over 50% of the automatically identified events.

[0006] According to an aspect, a machine-implemented technique can involve identifying atrial fibrillation events in physiological data obtained for a living being, obtaining heart rate data for the living being, and pictographically presenting, using a common time scale, information regarding the heart rate data during a defined time period and regarding duration of atrial fibrillation activity, according to the identified atrial fibrillation events, during the defined time period such that heart rate trend is presented with atrial fibrillation burden. Pictographically presenting information can involve presenting information regarding both incidence and duration of identified atrial fibrillation events during the defined time period. The heart rate data can be information presented in beats-per-minute. The heart rate data can be information presented in average beats-per-minute and can include information regarding standard deviation of heart rate.

[0007] Pictographically presenting information can involve presenting heart rate trend juxtaposed with atrial fibrillation burden. Pictographically presenting information can involve presenting heart rate trend and atrial fibrillation burden on the same graph. Pictographically presenting information can involve presenting heart rate trend and atrial fibrillation burden on different graphs.

[0008] Identifying atrial fibrillation events can involve examining the physiological data in time intervals, and identifying the intervals in which at least one atrial fibrillation event has occurred, and presenting information can involve displaying the identified intervals in alignment with the information regarding the heart rate data on the common time scale. Presenting information can involve selectively presenting the information based on a measure of correlation between the identified atrial fibrillation events and human-assessments of at least a portion of the identified atrial fibrillation events. Moreover, the machine-implemented technique can also involve receiving input specifying the defined time period.

[0009] According to another aspect, a machine-implemented technique can involve identifying arrhythmia events in physiological data obtained for a living being, the identified arrhythmia events representing a first group of data, receiving a second group of data that includes human assessments of at least a portion of the arrhythmia events, determining at least one measure of correlation between the first group of data and the second group of data, and if the measure of correlation matches or exceeds at least one predetermined value, selectively presenting, based on this measure of correlation, information regarding at least a portion of the arrhythmia events. This selective presentation can be based on a comparison of the measure of correlation with the at least one predetermined value (i.e., checking if the measure of correlation matches or exceeds, or matches or is less than, at least one predetermined value are both possible). Identifying arrhythmia events can involve identifying atrial fibrillation events, and selectively presenting information can involve presenting information regarding the atrial fibrillation events and heart rate data for the living being, during a defined time period, together with a common time scale if the measure of correlation indicates a high positive predictivity for the identification of atrial fi-

brillation events during the defined time period.

[0010] Receiving human assessments can involve receiving human assessments of a subset of the atrial fibrillation events, and identifying atrial fibrillation events can involve examining the physiological data in time intervals, identifying the intervals in which at least one atrial fibrillation event has occurred, and reporting the identified intervals. Presenting the information can involve displaying the identified intervals in alignment with the information regarding the heart rate data on the common time scale. The technique can also involve identifying a subset of the atrial fibrillation events that are urgent or representative, the identified subset being the human assessed subset. Determining a measure of correlation between the human assessments and the identified events can involve assessing, based on comparing at least time data, a number of the identified intervals that encompass at least a portion of human-assessed arrhythmia events.

[0011] Presenting the information regarding the heart rate data can involve displaying a heart rate trend graph including maximum heart rates in time intervals. Each of the heart rate intervals can be thirty minutes, and each of the atrial fibrillation intervals can be ten minutes. Presenting the information can involve displaying the information in two graphs using the common time scale. Presenting the information can involve displaying the information in a single graph using the common time scale.

[0012] According to another aspect, a system for reporting information related to arrhythmia events can include a monitoring system configured to process and report physiological data for a living being and configured to identify arrhythmia events from the physiological data, a monitoring station for receiving the physiological data from the monitoring system, a processing system configured to receive arrhythmia information from the monitoring system and configured to receive human-assessed arrhythmia information from the monitoring station wherein the human-assessed arrhythmia information derives from at least a portion of the physiological data and wherein the processing system reports information regarding arrhythmia events if a correlation measure relating to a correlation between the arrhythmia information from the monitoring system and the human-assessed arrhythmia information matches or exceeds a predetermined value. The processing system can be capable of presenting information regarding atrial fibrillation events and heart rate data for the living being, during a defined time period, together with a common time scale if the correlation measure indicates a high positive predictivity for the identification of atrial fibrillation events during the defined time period.

[0013] According to another aspect, a system for reporting information related to arrhythmia events can include a monitoring system configured to process and report physiological data, including heart rate data, for a living being and configured to identify arrhythmia events from the physiological data, a monitoring station for receiving the physiological data from the monitoring system, a processing system configured to receive arrhythmia information from the monitoring system and configured to receive human-assessed arrhythmia information from the monitoring station wherein the human-assessed arrhythmia information derives from at least a portion of the physiological data and wherein the processing system is capable of pictographically presenting, using a common time scale, information regarding the heart rate data during a defined time period and regarding duration of arrhythmia event activity, according to the identified arrhythmia events, during the defined time period such that heart rate trend is presented with arrhythmia event burden. The monitoring system can be capable of examining the physiological data in time intervals and identifying the intervals in which at least one atrial fibrillation event has occurred, and the processing system can be capable of displaying the identified intervals in alignment with the information regarding the heart rate data on the common time scale.

[0014] According to another aspect, a machine-implemented technique can involve obtaining heart rate data for a living being, identifying arrhythmia events in physiological data obtained for the living being, the identified arrhythmia events representing a first group of data, and wherein identifying arrhythmia events includes examining the physiological data in time intervals and identifying the intervals in which at least one arrhythmia events event has occurred, receiving a second group of data that includes human assessments of at least a portion of the arrhythmia events, determining at least one measure of correlation between the first group of data and the second group of data, wherein determining at least one measure of correlation includes assessing, based on comparing at least time data, a number of the identified intervals that encompass at least a portion of the human-assessed arrhythmia events, if the measure of correlation matches or exceeds at least one predetermined value, pictographically presenting, using a common time scale, information regarding the heart rate data during a defined time period and regarding duration of arrhythmia events activity, according to the identified arrhythmia events, during the defined time period such that heart rate trend is juxtaposed with arrhythmia event burden and wherein pictographically presenting includes displaying the identified intervals in alignment with the information regarding the heart rate data on the common time scale.

[0015] According to another aspect, a machine-implemented technique can involve identifying arrhythmia events in physiological data obtained for a living being, the identified arrhythmia events representing a first group of data, receiving a second group of data that includes human assessments of at least a portion of the arrhythmia events, determining at least one measure of correlation between the first group of data and the second group of data, and if the measure of correlation matches or exceeds at least one predetermined value, selectively presenting, based on this measure of correlation, information regarding at least a portion of the identified ar-

rhythmia events and wherein selectively presenting information involves presenting information regarding the identified arrhythmia events and heart rate data for the living being, during a defined time period, together with a common time scale if the measure of correlation indicates a high positive predictivity for the identification of arrhythmia events during the defined time period.

[0016] The systems and techniques described can be implemented using an article including a machine-readable medium embodying information indicative of instructions that when performed by one or more machines result in the operations described. The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features and advantages will become apparent from the description, the drawings, and the claims.

DRAWING DESCRIPTIONS

[0017]

FIG. 1 illustrates, according to an exemplary embodiment, a system for reporting information related to arrhythmia events.

FIG. 2 shows, according to one embodiment, a graph presenting an example of atrial fibrillation burden and heart rate trend.

FIG. 3 is a diagram illustrating, according to an exemplary embodiment, a procedure for monitoring, processing, and reporting information related to arrhythmia events.

FIG. 4 shows, according to an exemplary embodiment, one graph presenting an example of atrial fibrillation burden and one graph presenting an example of heart rate trend.

FIGS. 5 and 6 are diagrams illustrating, according to another exemplary embodiment, a procedure for monitoring, processing, and reporting information related to arrhythmia events.

DETAILED DESCRIPTION

[0018] FIG. 1 illustrates, according to one embodiment, a system for reporting information related to arrhythmia events, such as atrial fibrillation events. In this embodiment, monitoring system 109 can communicate (via devices 101 and 102) ECG (electrocardiogram), cardiac event, and other data to monitoring center 104. The system 109 can include, for example, an implantable medical device (IMD), such as an implantable cardiac defibrillator and an associated transceiver or pacemaker and an associated transceiver, or a monitoring device 101 that a patient 110 wears. Further, monitoring system 109 can include a monitor processing device 102 that can send standard physiological data (received from monitoring device 101) to monitoring center 104 and that can detect arrhythmia events (such as atrial fibrillation events). In one implementation, the devices 101 and 102 are integrated into a single device. Moreover, the system 109 can be implemented using, for example, the CardioNet Mobile Cardiac Outpatient Telemetry (MCOT) device, which is commercially available and provided by CardioNet, Inc of San Diego, CA.

[0019] Monitor processing device 102 can transmit physiological data (including data related to arrhythmia events) through a communication network 103, which can be a local area network (LAN), a landline telephone network, a wireless network, a satellite communication network, or other suitable network to facilitate two-way communication with monitoring center 104. Advantageously, monitoring center 104 can be located in the same location (e.g., in the same room or building) as monitoring system 109 or at some remote location.

[0020] The monitoring center 104 can include a monitoring (or display) station 105 and a processing system 106. In one implementation, a cardiovascular technician (CVT) can use the monitoring station 105 to evaluate physiological data received from monitoring system 109, identifying and reporting, among other things, arrhythmia events (such as atrial fibrillation events). The CVT reports these assessments of the physiological data to the processing system 106, which also receives information related to the arrhythmia events identified by monitoring system 109. As will be explained further below, processing system 106 analyzes this arrhythmia event data (both the human-assessed data from the CVT and the data reported by monitoring system 109) and determines whether to generate a graph (or other similar presentation) related to these events. In certain circumstances, the processing system will send a report related to both arrhythmia and heart rate data to, for example, a physician or other health care provider 108 via transmission path 107--which may be part of the network 103.

[0021] FIG. 3 illustrates, according to one embodiment, a procedure for monitoring, processing, and reporting arrhythmia event data (such as data associated with atrial fibrillation events). In this embodiment, the monitoring system 109 (illustrated in FIG. 1) monitors and reports physiological data (including data related to heart rate) at 301. At 302, various parts of this physiological data can be analyzed (for example, RR variability and QRS morphology) and arrhythmia events can be identified based on predefined criteria-the information relating to these events (among other possible information) constituting a first group of data. In one implementation, the monitoring system 109 identifies certain of the arrhythmia events that are urgent or representative and reports those events to both a CVT at 303 and to the processing system at 304. Alternatively, the system could simply report the events identified at 302 to the processing system. Further, at 303, a CVT, using station 105, evaluates various parts of the physiological data received from 302 and/or 301 and also identifies arrhythmia events--the information relating to these human-assessed events (among other possible information) constituting a second group of data. Here, if needed, the CVT

can request additional data from monitoring system 109.

[0022] At 304, the processing system 106 analyzes both the first and second group of data, determining a measure of correlation between these groups. This process can involve, for example, determining whether a correlation measure exceeds and/or equals a predetermined correlation parameter or whether a correlation measure is less than and/or equals that parameter. If, based on the correlation analysis, the information related to the arrhythmia events is determined to be valid, then the system generates a report relating to both heart rate trend and the arrhythmia events at 305, such as the graph shown in FIG. 2 or the graphs shown in FIG. 4. If, on the other hand, there is insufficient correlation, then the system does not generate a report and monitoring continues.

[0023] To illustrate, in one implementation, every ten minutes, the monitoring system 109 transmits a "flag" if it has detected an atrial fibrillation (AF) event in the last ten minutes. In this implementation, the processing system 106 only generates a graph (or graphs) related to heart rate trend and atrial fibrillation burden-such as the graph shown in FIG. 2 or the graphs shown in FIG. 4--if more than 50% of the ten minute flags (generated at 302) match events identified by a CVT (at 303)-a correlation (with respect to the time period at issue) indicating a high positive predictivity for the identification of AF events. If this 50% threshold is not met, then the system does not generate a graph (or graphs) based on the data at issue and simply continues to process data.

[0024] The term "atrial fibrillation burden" (or more generally, "arrhythmia event burden") refers generally to the overall amount of time that a patient is in atrial fibrillation (or arrhythmia) over a specified time period, taking into account the number and duration of episodes. Advantageously, employing pictographic presentations, such as those of FIGS. 2 and 4, a medical practitioner can see whether a patient is more likely to experience an arrhythmia, such as AF, at certain times of the day, and this can affect therapeutic approaches in some cases.

[0025] FIG. 2 represents one example of how to pictographically present both heart rate trend and atrial fibrillation burden on a common time scale (to "pictographically present" such data, however, a graph is not required.). The graph 205 contains information relating to, for example, daily AF incidence and time of occurrence 201, AF duration 202, and heart rate (203 and 204). A scale 204 (in this example) indicates heart rate in average beats-per-minute and the dots and lines shown at 203 (for example) indicate values on that scale, standard deviations associated with these values, and heart rates during AF. Further, graph 205 shows heart rate data at 15 minutes and 45 minutes past the hour. Finally, in this graph, the presence of one or more AF events in a given 10-minute period is graphed as a 10-minute interval.

[0026] Like FIG. 2, FIG. 4 represents an example of how to pictographically present heart rate trend and atrial fibrillation burden on a common time scale. Although FIG. 4, unlike FIG. 2, uses two graphs, FIG. 4 presents the same information as FIG. 2. Specifically, graphs 404 and 405 contain information relating to, for example, daily AF incidence and time of occurrence 401, AF duration 402, and heart rate (403 and 406). A scale 406 (in this example) indicates heart rate in average beats-per-minute and the dots and lines shown at 403 (for example) indicate values on that scale, standard deviations associated with these values, and heart rates during AF.

[0027] FIGS. 5 and 6 are diagrams illustrating another implementation of the invention. Specifically, at 501, the system 111, employing monitoring system 109, obtains physiological data, including heart rate data. In turn, at 502, the system identifies the presence of arrhythmia events (such as AF events) in this physiological data, examining this data in time intervals. At 503, the system assigns flags indicating the presence of arrhythmia events and reports those flags--which represent a first group of data--to the processing system. Similarly, at 504, the system identifies and reports physiological data, such as ECG data, for a subset of the events identified at 502 and reported at 503. Notably, the system, in this implementation, need not report physiological data for each flag assigned at 503, but need only report data associated with the most significant events identified at 502, thereby minimizing the data sent to a CVT.

[0028] At 601, the CVT analyzes this data and reports whether arrhythmia events have occurred, thereby generating a second group of data. The processing system then determines (at 602), based on comparing time stamps associated with each group of data, at least one measure of correlation between the first group of data and the second group of data. To illustrate, if enough of the human-assessed events reported at 601 match the events reported at 503, then the system determines that the data is valid, that is, that there is a high positive predictivity for the identification of arrhythmia events. If such a determination is made, the data associated with each flag reported at 503 is pictographically presented in a form such as FIG. 2 or FIG. 4. Significantly, in this implementation, while this pictographic representation can contain all such data, the CVT need only review a subset of this data. In short, the system achieves increased accuracy in the presentation of information relating to arrhythmia events while minimizing the data that the CVT reviews.

[0029] The disclosed system and all of the functional operations described and illustrated in this specification can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of the forgoing. Apparatus can be implemented in a software product (*e.g.,* a computer program product) tangibly embodied in a machine-readable storage device for execution by a programmable processor, and processing operations can be performed by a programmable processor executing a program of instructions to perform functions by operating on input data and generating output. Further, the system can be implemented advantageously in one or more software programs that

are executable on a programmable system. This programmable system can include the following: 1) at least one programmable processor coupled to receive data and instructions from, and to transmit data and instructions to, a data storage system; 2) at least one input device; and 3) at least one output device. Moreover, each software program can be implemented in a high-level procedural or object-oriented programming language, or in assembly or machine language if desired; and in any case, the language can be a compiled or an interpreted language.

[0030] Also, suitable processors include, by way of example, both general and special purpose microprocessors. Generally, a processor will receive instructions and data from a read-only memory, a random access memory, and/or a machine-readable signal (e.g., a digital signal received through a network connection). Generally, a computer will include one or more mass storage devices for storing data files. Such devices can include magnetic disks, such as internal hard disks and removable disks, magneto-optical disks, and optical disks. Storage devices suitable for tangibly embodying software program instructions and data include all forms of non-volatile memory, including, by way of example, the following: 1) semiconductor memory devices, such as EPROM (electrically programmable read-only memory); EEPROM (electrically erasable programmable read-only memory) and flash memory devices; 2) magnetic disks such as internal hard disks and removable disks; 3) magneto-optical disks; and 4) CD-ROM disks. Any of the foregoing can be supplemented by, or incorporated in, ASICs (application-specific integrated circuits).

[0031] To provide for interaction with a user (such as the CVT), the system can be implemented on a computer system having a display device such as a monitor or LCD (liquid crystal display) screen for displaying information to the user and a keyboard and a pointing device such as a mouse or a trackball by which the user can provide input to the computer system. The computer system can be programmed to provide a graphical user interface through which computer programs interact with users.

[0032] Finally, while the foregoing system has been described in terms of particular implementations, other embodiments are within the scope of the following claims. For example, the disclosed operations can be performed in a different order and still achieve desirable results. Moreover, the system need not employ 10-minute intervals; many different time intervals are possible (as is no interval at all), including 1 minute, 30 second, and 30-minute intervals. Indeed, because time intervals are not required, the graphs of FIGS. 2 and 4 could be modified to show continuous heart rate trend (accompanied by corresponding AF data) rather than just specific instances of this trend. Further, while FIGS. 2 and 4 show examples of (among other things) pictographically presenting atrial fibrillation burden (one type of arrhythmia event burden), one could present the same or similar information for another type of arrhythmia event. In fact, one could employ both the format and procedures associated with generating FIG. 2 or FIG. 4 (or a similar figure) to pictographically present information related to a number of different types of arrhythmia event burdens.

Claims

1. A machine-implemented method comprising:

identifying arrhythmia events in physiological data obtained for a living being;
obtaining heart rate data for the living being;
characterized by
pictographically presenting, using a common time scale, information regarding the heart rate data during a defined time period and regarding duration of arrhythmia activity, according to the identified arrhythmia events, during the defined time period such that heart rate trend is presented with arrhythmia burden, wherein presenting information comprises selectively presenting the information based on a measure of correlation between the identified arrhythmia events and human-assessments of at least a portion of the identified arrhythmia events.

2. The method of claim 1, wherein the arrhythmia events are atrial fibrillation events.

3. The method of claim 2, wherein pictographically presenting information comprises presenting information regarding both incidence and duration of identified atrial fibrillation events during the defined time period.

4. The method of claim 2 or claim 3 wherein the heart rate data comprise information presented in beats-per-minute.

5. The method of claim 4, wherein the heart rate data comprise information presented in average beats-per-minute and comprises information regarding standard deviation of heart rate.

6. The method of any of claims 2 to 5, wherein pictographically presenting information comprises presenting heart rate trend juxtaposed with atrial fibrillation burden.

7. The method of any of claims 2 to 6, wherein pictographically presenting information comprises presenting heart rate trend and atrial fibrillation burden on the same graph.

8. The method of any one of claims 2 to 6, wherein pictographically presenting information comprises presenting heart rate trend and atrial fibrillation bur-

den on different graphs.

9. The method of any one of claims 2 to 8, wherein identifying atrial fibrillation events comprises examining the physiological data in time intervals, and identifying the intervals in which at least one atrial fibrillation event has occurred, and wherein presenting information comprises displaying the identified intervals in alignment with the information regarding the heart rate data on the common time scale.

10. The method of any one of the preceding claims further comprising receiving input specifying the defined time period.

11. An article comprising a machine-readable medium embodying information indicative of instructions that when performed by one or more machines results in operations comprising the steps of any one of claims 1 to 10.

12. An apparatus comprising:

means for identifying arrhythmia events in physiological data obtained for a living being;
means for obtaining heart rate data for the living being; and
means for pictographically presenting, using a common time scale, information regarding the heart rate data during a defined time period and regarding duration of arrhythmia activity, according to the identified arrhythmia events, during the defined time period such that heart rate trend is presented with arrhythmia burden;
wherein the means for pictographically presenting information comprises means for selectively presenting the information based on a measure of correlation between the identified arrhythmia events and human-assessments of at least a portion of the identified arrhythmia events.

13. The apparatus of claim 12, wherein the arrhythmia events are atrial fibrillation events.

14. The apparatus of claim 13, wherein the means for pictographically presenting is capable of presenting information regarding the atrial fibrillation events and heart rate data for the living being, during a defined time period, together with a common time scale if the measure of correlation indicates a high positive predictivity for the identification of atrial fibrillation events during the defined time period.

Patentansprüche

1. Maschinenimplementiertes Verfahren, umfassend:

Identifizieren von Arrhythmie-Ereignissen in von einem Lebewesen erhaltenen physiologischen Daten;
Erhalten von Herzfrequenzdaten von dem Lebewesen; **gekennzeichnet durch**
piktographisches Darstellen von Informationen zu den Herzfrequenzdaten während eines definierten Zeitraums und zu der Dauer von Arrhythmie-Aktivität entsprechend den identifizierten Arrhythmie-Ereignissen während des definierten Zeitraums unter Verwendung einer gemeinsamen Zeitskala, so dass der Herzfrequenzverlauf mit der Arrhythmielast dargestellt wird, wobei das Darstellen von Informationen selektives Darstellen der Informationen auf der Grundlage eines Korrelationsmaßes zwischen den identifizierten Arrhythmie-Ereignissen und menschlichen Beurteilungen wenigstens eines Teils der identifizierten Arrhythmie-Ereignisse umfasst.

2. Verfahren gemäß Anspruch 1, wobei die Arrhythmie-Ereignisse Vorhofflimmern-Ereignisse sind.

3. Verfahren gemäß Anspruch 2, wobei piktographisches Darstellen von Informationen Darstellen von Informationen sowohl zu dem Auftreten als auch zu der Dauer von identifizierten Vorhofflimmern-Ereignissen während des definierten Zeitraums umfasst.

4. Verfahren gemäß Anspruch 2 oder Anspruch 3, wobei die Herzfrequenzdaten in Schlägen pro Minute dargestellte Informationen umfassen.

5. Verfahren gemäß Anspruch 4, wobei die Herzfrequenzdaten in mittleren Schlägen pro Minute dargestellte Informationen umfassen und Informationen zu der Standardabweichung der Herzfrequenz umfassen.

6. Verfahren gemäß einem der Ansprüche 2 bis 5, wobei piktographisches Darstellen von Informationen Darstellen des Herzfrequenzverlaufs gegenüber der Vorhofflimmern-Last umfasst.

7. Verfahren gemäß einem der Ansprüche 2 bis 6, wobei piktographisches Darstellen von Informationen Darstellen von Herzfrequenzverlauf und Vorhofflimmern-Last in dem gleichen Schaubild umfasst.

8. Verfahren gemäß einem der Ansprüche 2 bis 6, wobei piktographisches Darstellen von Informationen Darstellen von Herzfrequenzverlauf und Vorhofflimmern-Last in verschiedenen Schaubildern umfasst.

9. Verfahren gemäß einem der Ansprüche 2 bis 8, wobei Identifizieren von Vorhofflimmern-Ereignissen Untersuchen der physiologischen Daten in Zeitintervallen und Identifizieren der Intervalle, in denen we-

nigstens ein Vorhofflimmern-Ereignis stattgefunden hat, umfasst und wobei das Darstellen von Informationen das Darstellen der identifizierten Intervalle angeglichen mit den Informationen zu den Herzfrequenzdaten auf der gemeinsamen Zeitskala umfasst.

10. Verfahren gemäß einem der vorstehenden Ansprüche, ferner umfassend das Empfangen einer Eingabe, die den definierten Zeitraum spezifiziert.

11. Gegenstand, umfassend ein maschinenlesbares Medium, das Informationen enthält, die Anweisungen anzeigen, die bei Ausführung durch eine oder mehrere Maschinen zu Arbeitsvorgängen führen, die die Schritte gemäß einem der Ansprüche 1 bis 10 umfassen.

12. Vorrichtung umfassend:

Mittel zum Identifizieren von Arrhythmie-Ereignissen in von einem Lebewesen erhaltenen physiologischen Daten;
Mittel zum Erhalten von Herzfrequenzdaten von dem Lebewesen; und
Mittel zum piktographisches Darstellen von Informationen zu den Herzfrequenzdaten während eines definierten Zeitraums und zu der Dauer der Arrhythmie-Aktivität entsprechend den identifizierten Arrhythmie-Ereignissen während des definierten Zeitraums unter Verwendung einer gemeinsamen Zeitskala, so dass der Herzfrequenzverlauf mit der Arrhythmielast dargestellt wird;
wobei das Mittel zum piktographischen Darstellen von Informationen Mittel zum selektiven Darstellen der Informationen auf der Grundlage eines Korrelationsmaßes zwischen den identifizierten Arrhythmie-Ereignissen und menschlichen Beurteilungen wenigstens eines Teils der identifizierten Arrhythmie-Ereignisse umfasst.

13. Vorrichtung gemäß Anspruch 12, wobei die Arrhythmie-Ereignisse Vorhofflimmern-Ereignisse sind.

14. Vorrichtung gemäß Anspruch 13, wobei das Mittel zum piktographischen Darstellen fähig ist, Informationen zu den Vorhofflimmern-Ereignissen und zu den Herzfrequenzdaten für das Lebewesen während eines definierten Zeitraums zusammen mit einer gemeinsamen Zeitskala darzustellen, wenn das Korrelationsmaß einen hohen positiven Vorhersagewert zur Identifikation von Vorhofflimmern-Ereignissen während des definierten Zeitraums anzeigt.

Revendications

1. Procédé mis en oeuvre par machine comportant les étapes consistant à :

identifier des événements arythmiques dans des données physiologiques obtenues pour un être vivant ;
obtenir des données de rythme cardiaque pour l'être vivant ; **caractérisé par** les étapes consistant à présenter de façon pictographique, en utilisant une échelle de temps commune, des informations concernant les données de rythme cardiaque pendant un laps de temps défini et concernant la durée de activité d'arythmie, d'après les événements arythmiques identifiés, pendant le laps de temps défini de telle façon qu'une tendance de rythme cardiaque soit présentée avec la charge d'arythmie, la présentation des informations comportant les étapes consistant à présenter sélectivement les informations sur la base d'une mesure de corrélation entre les événements arythmiques identifiés et des appréciations humaines d'au moins une partie des événements arythmiques identifiés.

2. Procédé selon la revendication 1, les événements arythmiques étant des événements de fibrillation auriculaire.

3. Procédé selon la revendication 2, la présentation pictographique d'informations comportant l'étape consistant à présenter des informations concernant à la fois l'incidence et la durée d'événements identifiés de fibrillation auriculaire pendant le laps de temps défini.

4. Procédé selon la revendication 2 ou la revendication 3, les données de rythme cardiaque comportant des informations présentées en battements par minute.

5. Procédé selon la revendication 4, les données de rythme cardiaque comportant des informations présentées en battements par minute moyens et comportant des informations concernant l'écart-type du rythme cardiaque.

6. Procédé selon l'une quelconque des revendications 2 à 5, la présentation pictographique d'informations comportant l'étape consistant à présenter la tendance de rythme cardiaque juxtaposée avec la charge de fibrillation auriculaire.

7. Procédé selon l'une quelconque des revendications 2 à 6, la présentation pictographique d'informations comportant l'étape consistant à présenter la tendance de rythme cardiaque et la charge de fibrillation auriculaire sur le même graphique.

8. Procédé selon l'une quelconque des revendications 2 à 6, la présentation pictographique d'informations comportant l'étape consistant à présenter la tendance de rythme cardiaque et charge de fibrillation auriculaire sur des graphiques différents.

9. Procédé selon l'une quelconque des revendications 2 à 8, l'identification d'événements de fibrillation auriculaire comportant les étapes consistant à examiner les données physiologiques dans des intervalles de temps et à identifier les intervalles au cours desquels au moins un événement de fibrillation auriculaire s'est produit, et la présentation d'informations comportant l'étape consistant à afficher les intervalles identifiés en alignement avec les informations concernant les données de rythme cardiaque sur l'échelle de temps commune.

10. Procédé selon l'une quelconque des revendications précédentes, comportant en outre l'étape consistant à recevoir une entrée spécifiant le laps de temps défini.

11. Article comportant un support lisible par machine renfermant des informations indicatives d'instructions qui, lorsqu'elles sont exécutées par une ou plusieurs machines, se traduisent par des opérations comportant les étapes de l'une quelconque des revendications 1 à 10.

12. Appareil comportant :

un moyen d'identification d'événements arythmiques dans des données physiologiques obtenues pour un être vivant ;
un moyen d'obtention de données de rythme cardiaque pour l'être vivant ; et
un moyen de présentation pictographique, en utilisant une échelle de temps commune, d'informations concernant les données de rythme cardiaque pendant un laps de temps défini et concernant la durée de activité d'arythmie, d'après les événements arythmiques identifiés, pendant le laps de temps défini de telle façon qu'une tendance de rythme cardiaque soit présentée avec la charge d'arythmie ;
le moyen de présentation pictographique d'informations comportant un moyen servant à présenter sélectivement les informations sur la base d'une mesure de corrélation entre les événements arythmiques identifiés et des appréciations humaines d'au moins une partie des événements arythmiques identifiés.

13. Appareil selon la revendication 12, les événements arythmiques étant des événements de fibrillation auriculaire.

14. Appareil selon la revendication 13, le moyen de présentation pictographique étant capable de présenter des informations concernant les événements de fibrillation auriculaire et les données de rythme cardiaque pour l'être vivant, pendant un laps de temps défini, conjointement avec une échelle de temps commune si la mesure de corrélation indique une prédictivité positive élevée pour l'identification d'événements de fibrillation auriculaire pendant le laps de temps défini.

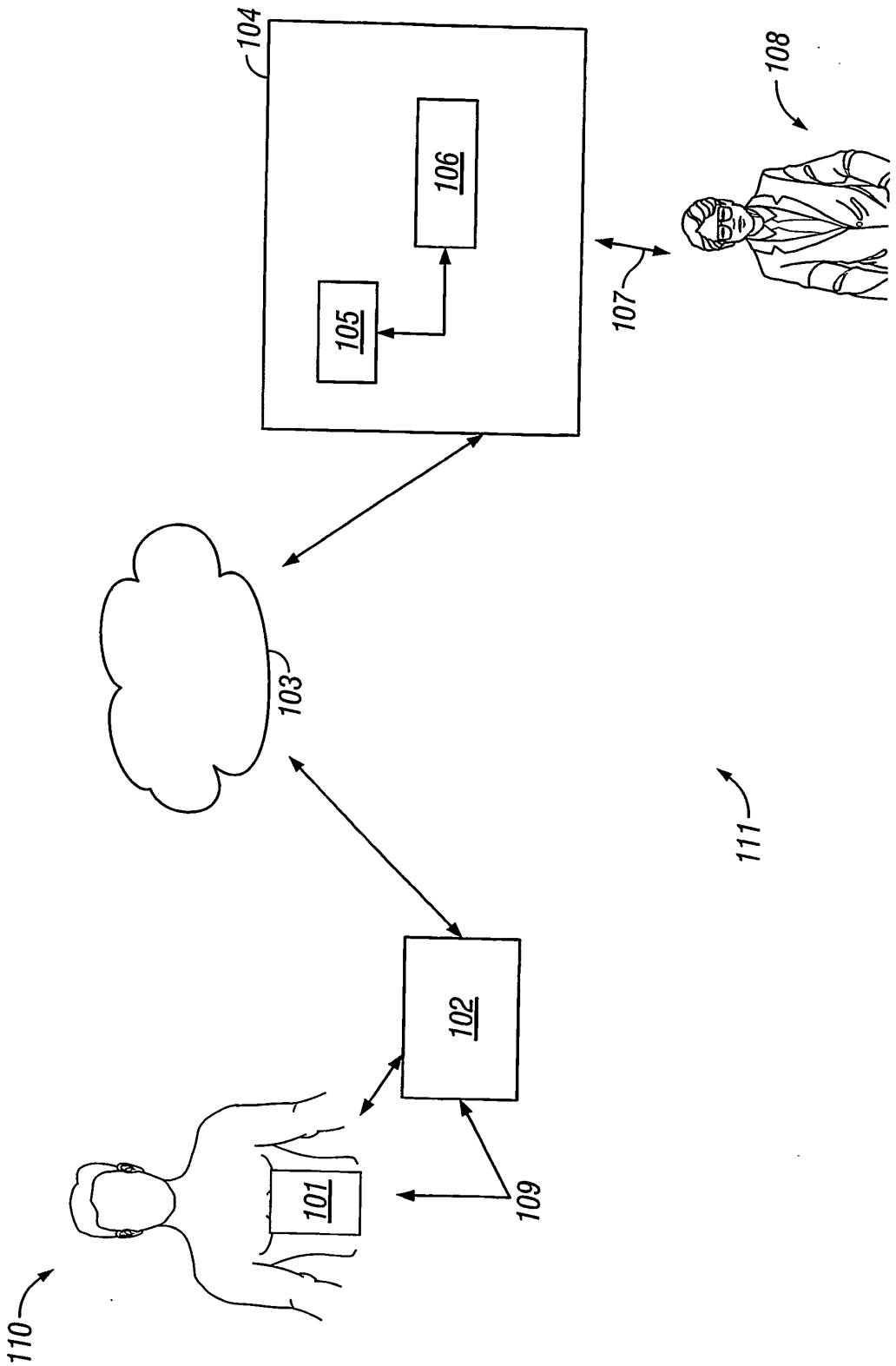

FIG. 1

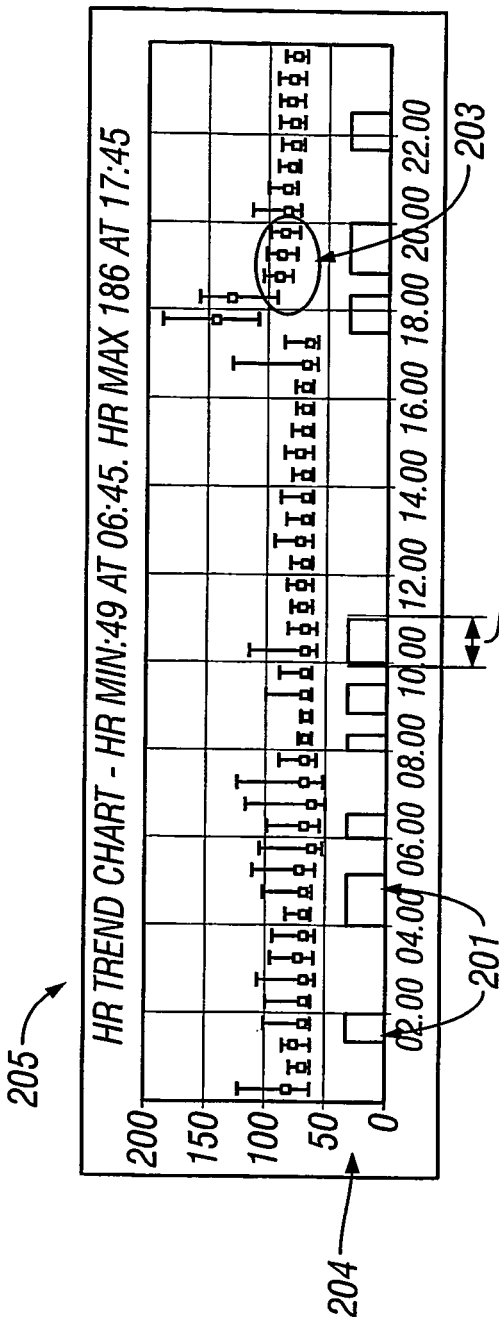
HR TREND CHART - HR MIN:49 AT 06:45. HR MAX 186 AT 17:45
200
150
100
50
0
02.00 04.00 06.00 08.00 10.00 12.00 14.00 16.00 18.00 20.00 22.00
201
202
203
204
205

FIG. 2

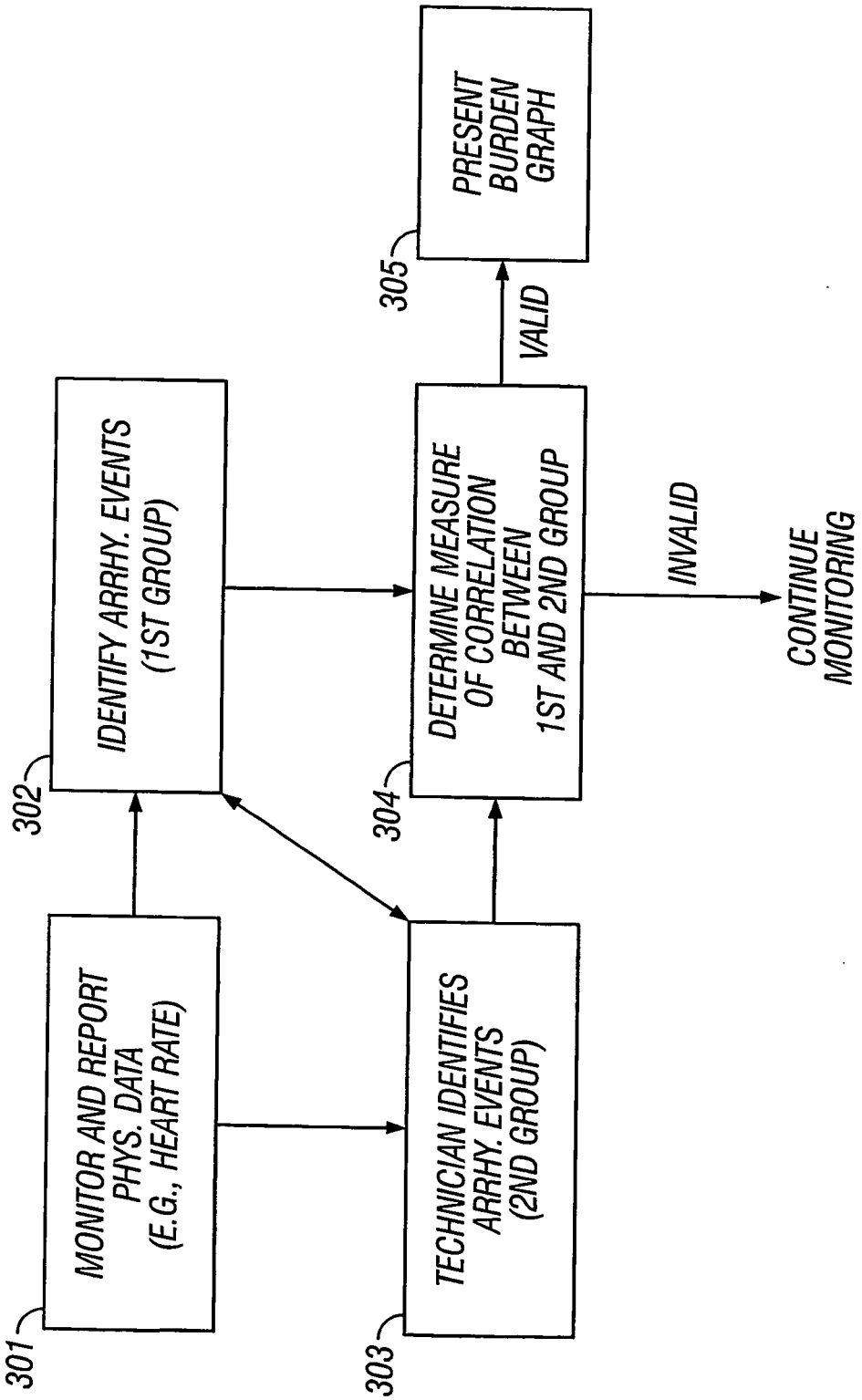
MONITOR AND REPORT PHYS. DATA (E.G., HEART RATE)
301
IDENTIFY ARRHY. EVENTS (1ST GROUP)
302
TECHNICIAN IDENTIFIES ARRHY. EVENTS (2ND GROUP)
303
DETERMINE MEASURE OF CORRELATION BETWEEN 1ST AND 2ND GROUP
304
PRESENT BURDEN GRAPH
305
VALID
INVALID
CONTINUE MONITORING

FIG. 3

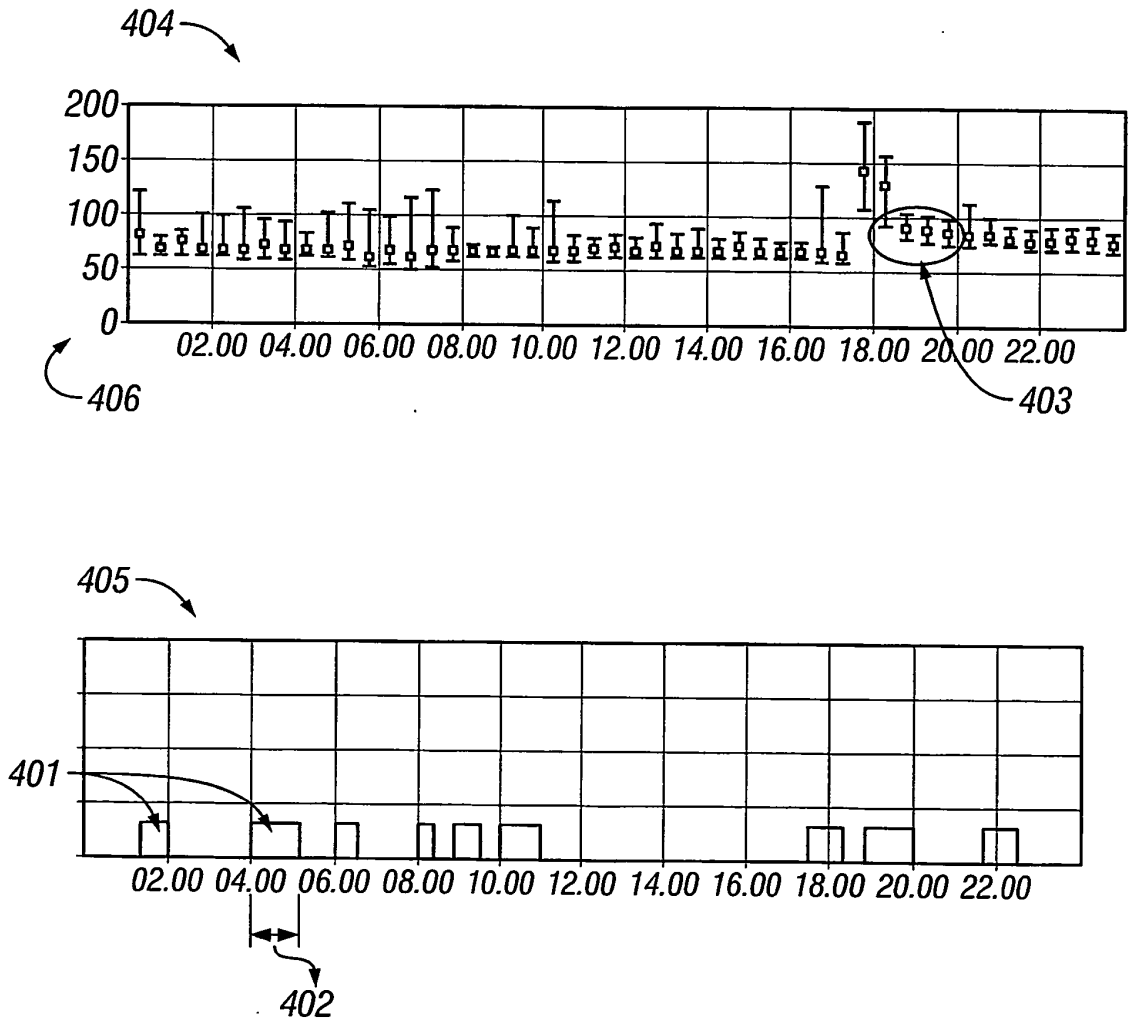
404
200
150
100
50
0
02.00 04.00 06.00 08.00 10.00 12.00 14.00 16.00 18.00 20.00 22.00
406
403
405
401
02.00 04.00 06.00 08.00 10.00 12.00 14.00 16.00 18.00 20.00 22.00
402

FIG. 4

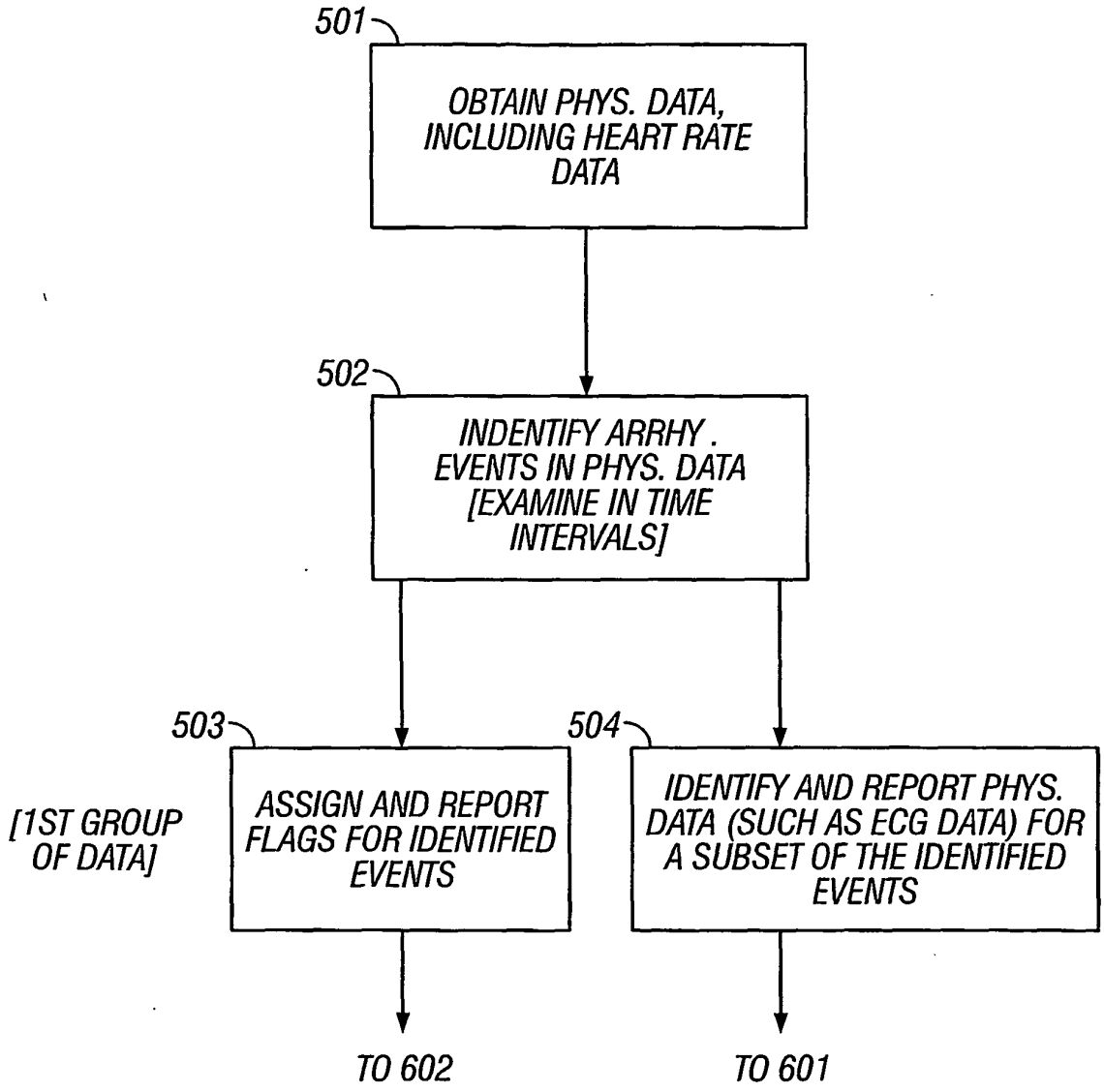
501
OBTAIN PHYS. DATA, INCLUDING HEART RATE DATA
502
INDENTIFY ARRHY . EVENTS IN PHYS. DATA [EXAMINE IN TIME INTERVALS]
503
504
[1ST GROUP OF DATA]
ASSIGN AND REPORT FLAGS FOR IDENTIFIED EVENTS
IDENTIFY AND REPORT PHYS. DATA (SUCH AS ECG DATA) FOR A SUBSET OF THE IDENTIFIED EVENTS
TO 602
TO 601

FIG. 5

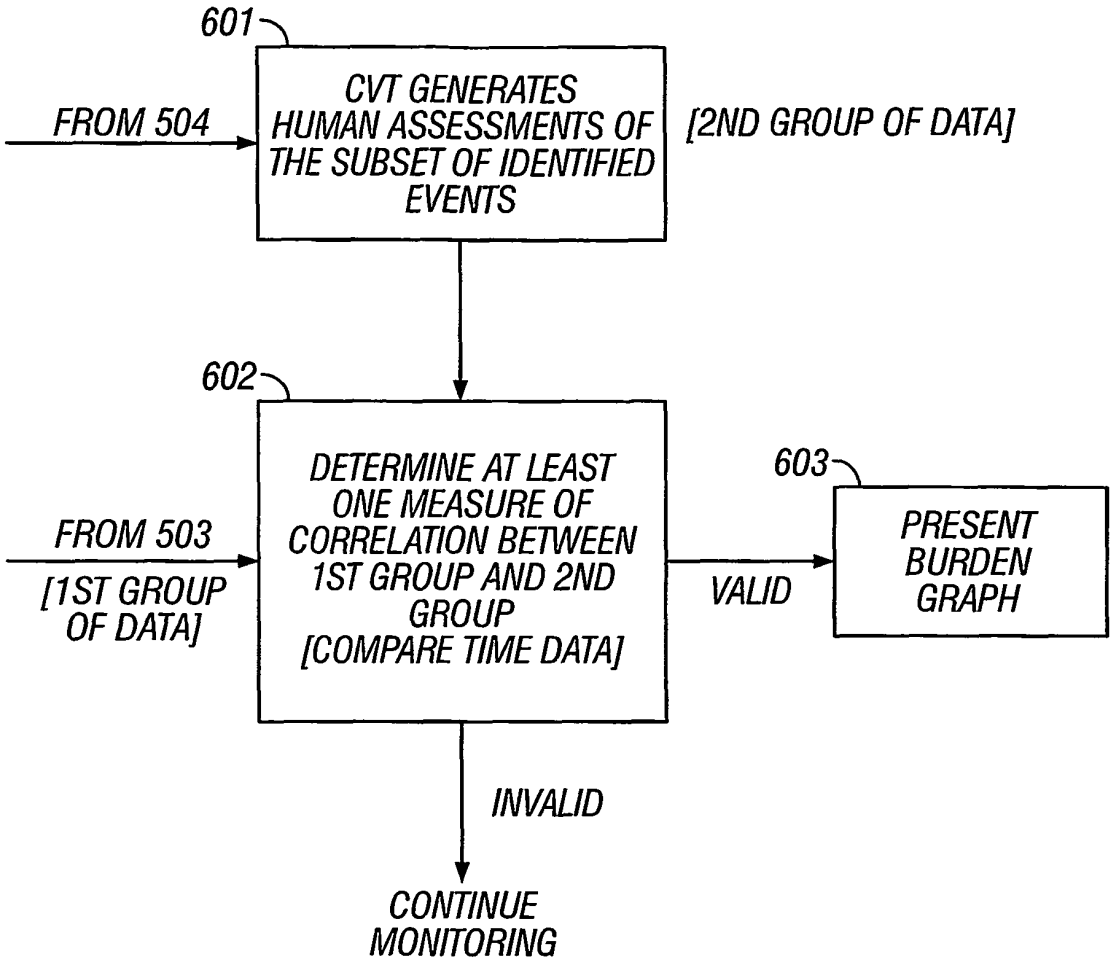
601
CVT GENERATES HUMAN ASSESSMENTS OF THE SUBSET OF IDENTIFIED EVENTS
FROM 504
[2ND GROUP OF DATA]
602
DETERMINE AT LEAST ONE MEASURE OF CORRELATION BETWEEN 1ST GROUP AND 2ND GROUP [COMPARE TIME DATA]
FROM 503
[1ST GROUP OF DATA]
603
PRESENT BURDEN GRAPH
VALID
INVALID
CONTINUE MONITORING

FIG. 6

专利名称(译)	用于处理和呈现心律失常信息以促进心律失常识别和治疗的系统和方法		
公开(公告)号	EP1691683A4	公开(公告)日	2010-12-01
申请号	EP2004702945	申请日	2004-01-16
申请(专利权)人(译)	CARDIONET INC.		
当前申请(专利权)人(译)	CARDIONET INC.		
[标]发明人	PRYSTOWSKY ERIC N KORZINOV LEV BAUMANN ERIC DENIS SCOTT JAIME MANUEL E JAMES JUSTIN		
发明人	PRYSTOWSKY, ERIC, N. KORZINOV, LEV BAUMANN, ERIC DENIS, SCOTT JAIME, MANUEL, E. JAMES, JUSTIN		
IPC分类号	A61B5/0464 A61B5/00 A61B5/0245 A61B5/044 A61B5/046		
CPC分类号	A61B5/046 A61B5/0006 A61B5/0245 A61B5/044 A61B5/7246 A61B5/7282 A61B5/742		
优先权	60/525386 2003-11-26 US		
其他公开文献	EP1691683B1 EP1691683A1		
外部链接	Espacenet		

摘要(译)

用于呈现与心脏数据有关的信息的系统和方法可以涉及包括识别为生物获得的生理数据中的心律失常事件，接收对至少一部分心律失常事件的人体评估，确定人类评估与之间的相关性度量的操作。所识别的事件，并基于相关性度量选择性地呈现关于所识别的事件的信息。该操作还可以包括识别为生物获得的生理数据中的心房颤动事件，获得生物的心率数据，并且以象形方式呈现关于心率数据和心房颤动事件的持续时间的信息以及共同的时间尺度。表示在规定时间段内心房颤动负荷的心率趋势。